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FACTORS AFFECTING PRODUCTIVITY OF SOME LANDS IN THE WILLAMETTE BASIN OF NORTHWESTERN OREGON FOR DOUGLAS FIR TIMBER

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Factors affecting productivity of some lands in the Willamette Basin of Northwestern Oregon for douglas fir timber

by

Paul E. Lemmon 1/

INTRODUCTION

In order to have adequate information about the productive capacity of land in the Willamette Valley for timber, the Soil Conservation Service began a study of site quality for douglas fir in relation to permanent land and climatic factors during the winter of 1951-52. The study was needed so that the greatest possible use of existing information could be made. This report summarizes the work and presents a simple key by which land owners and technicians can obtain a reliable estimation of site index for douglas fir on any parcel of land from conservation survey and other conveniently available information irrespective of existing plant cover. With site index information the productive capacity is available from published sources.

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Recognition is hereby given to J. Melvin Williams, Soil Conservation Survey Supervisor, Albany, Oregon, under whose immediate supervision the soils information was collected and who was instrumental in helping carry out the work in all phases. A number of Soil Scientists under Williams' direction helped in accumulating field information for this study. Specifically they were Ralph B. Cleveland, William P. Badurina, Harold W. Biggerstaff and Clarence R. Olds. Several other field men also helped in obtaining the data.

Recognition is also given to the following Soil Conservation Service employees for their efforts in helping plan and direct the work and in providing the administrative arrangements for its successful completion: William W. Hill, Oregon State Soil Scientist, Samuel L. Sloan and Robert L. Brown, Oregon State Conservationist and Assistant respectively, Stanley W. Cosby and Theodore B. Plair, Regional Chiefs of the Conservation Surveys and Forestry Divisions respectively, and William R. Van Dersal, Regional Chief of Operations.

Some introductory and background information is helpful in gaining a thorough and rapid understanding of this study and how it fits into the work of the Soil Conservation Service.

The basic physical objective of the Soil Conservation Service is to obtain use of each acre of land within its capabilities and to have each acre treated in accordance with its needs for protection and improvement. In order to accomplish this objective, work has progressed along three main fronts. 1. Inventorying the physical land resources. Commonly this is known as the conservation survey, or more recently the soil survey, in which the important permanent (and sometimes temporary) factors of the land are recognized and mapped in such a way as to be available to land owners and technicians to promote satisfactory progress in the next two phases. 2. Classifying the land into units which are similar with respect to limitations and hazards under permanent use. This classification first includes the capability class, then sub-class and finally the capability units or treatment units designed to provide a basis for specific land-treatment recommendations. 3. Development and application of treatment recommendations to finally accomplish the objective. In order to be most effective and efficient each phase must be carried out with a full understanding and appreciation of the others. In addition all sources of available information must be drawn upon and in some respects adequate information is not yet available to satisfactorily accomplish the objective. This last phase has been carried out cooperatively with other technical agencies and through farmer-organized and administered Soil Conservation Districts.

One important item of information (limitation) needed to carry out phase 2 and 3 satisfactorily is that concerning productivity of the land for the crop(s) concerned. Much general information exists concerning production of agricultural crops. This is due to experimentation, many field trials and the combined experience of many farmers. Differences in soil management for agricultural crops are important. This variable is difficult to control while accumulating information. For that reason specific information about productivity of different lands for agricultural crops is not as thoroughly known as one would at first think. Less information is available for tree crops than for agricultural crops because experimentation has not proceeded as fast or as far, tree crops often require a lifetime to develop, and experience is accumulated much more slowly. The item of soil management, however, does not complicate the business of obtaining this information for timber crops like it does for agricultural crops. Can the work in phase one mentioned above provide some of this missing information? Such is the question stimulating the present work dealing with productive capacity of the land for timber.

The mechanical problems in obtaining accurate bulk measurements of forest production are more difficult than that for agricultural crops. Accordingly foresters have developed a method of estimating forest production of fully stocked stands by means of growth curves for different site quality classes and carefully prepared yield tables. In order to use this method to determine the productive capacity of any piece of land when fully stocked (used in accordance with its capabilities) one must be able to determine the site index. The

site index is the ratio of average height to average age, of some segment of the tree population such as the dominant or codominant trees, at some particular age. For douglas fir, as an example, this ratio at 100 years of age is considered to be the site index. The site index tells which growth curve (site quality class) and which yield tables to use in estimating expected production of fully stocked stands at different ages.

In order to obtain a valid site index measurement, however, determinations must be made from existing timber stands which are "normally" stocked, are within prescribed limits of age (even-aged) and are unmanaged or unaffected by abnormal circumstances. Not all of the forest lands, or lands thought to be suited to permanent forest production, have stands which will furnish a valid measure of site index. Many acres are cleared, burned, logged, covered with brush, or poorly stocked. These lands may not be producing in accordance with their capabilities and probably need sound treatment recommendations. What are the capabilities of these lands? What are the economically practical treatment recommendations needed? As a first requirement in answering these questions, what is the productive capacity of these lands for timber?

The answer to the last question can be obtained through correlation with some easily recognizable, measurable and mappable permanent factor or factors of the environment. Previous work by a number of authors indicates this to be true.

LITERATURE REVIEW

In order to make this report more useful and complete a summary has been made of the more relevent articles of somewhat recent origin. This literature review follows:

Arend and Gysel (1)* have studied the effects of soil and topography on red and black oak yields in southern Michigan. They found that combinations of soil texture and topography which provides moisture retention in the soil promotes higher production. On flat lands, or where the influence of slope is negligible, production was greatest on heavy textured soils, less on medium textured soils and least on light textured soils. When these same textures occur on slopes a position effect is noted and the relationship between texture and growth appears to be somewhat reversed from that on level positions. For instance growth trends seemed to be greater at lower slope, less at midslope and least at upper slope positions in each of the three textural classes but these conditions were more pronounced on the lighter textured soils and on the steeper slopes. The authors point out that slope and soil texture have considerable effect on surface and subsurface drainage. Moisture is lost from upper and gained by lower slopes through drainage. This occurs to a greater degree as soil textures become lighter and as slopes become steeper. Yield of oak on these three soil textures at different slope positions and on different slope gradients correlated with this tendency for loss or gain of soil moisture through drainage.

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* Numbers in parentheses refer to literature cited.

Auten (2) studied methods of predicting site index for yellow poplar from soil and topographic information on old-fields and cut-over areas of Tennessee, Kentucky, Ohio, Indiana and Illinois. The study included 77 natural second-growth stands. Chemical properties of the soil such as calcium, magnesium, phosphorus, potassium and total nitrogen content and reaction pH were found to be of no value in predicting site index. Color of the subsoil was found to be correlated satisfactorily with production when it was classified into two broad groups representing "well aerated" and "poorly aerated" soils. Subsoil drainage and surface texture were correlated with production when each factor was classified among 3 broad groups. No relation could be seen between thickness of the "B" horizon, as generally defined, and site index. The author appears to have recognized that permeability of the B horizon and not its thickness was more important. Reclassifying the data to reflect total depth to subsoil (as measured, or by assigning the value of 36 inches for plots having weakly developed B horizons) gave a highly significant correlation. A positive relationship was also found between site index and the thickness of the A_1 horizon. A curve is presented showing this relationship for thicknesses from 1 to 12 inches. The author indicates that this relationship is a useful measure but insufficient in itself for determining site index without considering depth to tight subsoil. The effects of topographic characteristics were investigated in terms of site, aspect, exposure, position, slope and elevation. Site was classified as either "cove", "slope" or "ridge". Aspect as either "cool" or "hot", exposure as either "sheltered" or "open"

and position as either "lower" or "upper". These factors were used in developing a table giving site index point values to subtract for different interactions of these factors. The effects of slope and elevation are discussed and some suggestions given concerning minimum differences considered to be significant in site index estimations. A table and instructions are given for the purpose of estimating site index in the field.

Auten (3) reports some soil factors associated with site quality for planted black locust and black walnut in the states of Tennessee, Kentucky, Illinois, Indiana, Ohio, Michigan, Pennsylvania, New York, Iowa and Missouri. His work is based on measurements taken from 120 plantings of black walnut and 135 plantings of black locust. The former stands varied in age from 6 to 75 years whereas the latter varied between 3 and 52 years. Site index, as ordinarily defined, was obtained from published growth curves and used for the purpose of correlation. Factors tested were drainage, plasticity, compactness and color of the subsoil, thickness and texture of the A and B horizons, total nitrogen content, organic carbon and reaction. Each of the four soil characteristics, drainage, plasticity, compactness and color, were rated in the field in one or the other of 6 code-classes. Average site index by code-class for each of these factors (apparently irrespective of the others) showed a fairly consistent trend from low, in class 1, to high, in class 6. This was true for both species. A profile number code in six classes, derived from a consideration of the composit effects of other soil properties governing drainage, correlated with site index in the same way. A significant positive relationship with

site index was found with respect to thickness of the A horizon. This was complicated by the nature of the B horizon and the author states that "the truest and simplist criterion in this situation is depth to tight subsoil regardless of any technical horizon separation". Technical definitions of the A and B horizons were adhered to in developing the statistical correlation between site index and thickness of the A horizon. No depth of the A horizon was recorded greater than 36 inches as it was assumed that the effect of pervious surface soil would be inoperative or greatly reduced at and below 36 inches. No correlations were obtained between site index and total nitrogen, organic carbon or reaction. There appeared to be a correlation between site index and surface texture. The higher indexes being common to silt loams, sandy loams and lighter soils whereas the lower indexes were found to be associated with clay, silty clay loam and heavier surface textured soils. The study provided the basis for 8 specific conclusions which should be of considerable value in determining planting programs for these two species.

Chandler et al (5) studied the relation between seven important soil types in the east Texas pine belt and the growth of loblolly and shortleaf pine. The study is based on 14 approximately one-acre plots each including a single soil type. The mean site index for these species was determined for each soil type and the data analyzed for variance according to standard procedure. The results are summarized below:

Soil type	Mean site index Loblolly pine	Shortleaf pine
Ochlockonee fine sandy loam	103	100
Lufkin fine sand	82	74
Segno fine sandy loam	81	72
Ruston fine sandy loam	80	74
Caddo fine sandy loam	78	73
Susquehanna fine sandy loam	73	68
Segno fine sand	58	62
Difference necessary for significance between means	11.5	6.6

The authors indicate that soil type proved to be the best indicator for site quality. In this study loblolly pine grew slightly better than shortleaf pine on every soil type studied except in one case. Here growth was low for both species. The general characteristics of each soil type are described and discussed with respect to growth.

Coile (6) presents background information on the use of ground vegetation and measurements of forest production as indicators of forest (site) types. "The fundamental hypotheses behind the use of forest (site) types are that: 1. the ground vegetation reflects the inherent quality of site better and with less variation than do forest stands; and 2. forest (site) types are to a high degree independent of the composition, age, and density of the forest stand that may occupy an area at any given time." The validity of these hypotheses is questioned. He indicates that early advocates of classifying forest land by using ground-vegetation types offered the following arguments against using forest stands as measures of site quality: 1. differences in results obtained from using different kinds of stand growth measurements, such as height growth, diameter growth, and volume growth; 2. differences in measurements due to differences in initial and subsequent stand density; and 3. differences in past history of stands

that influence development. He points out the ecological concept that combined factors influencing growth and reproduction of forest stands may be classified into four groups, climatic, edaphic, physiographic and biotic. In any given climatic region the important and relatively stable factors that differentiate site are those classed as edaphic and physiographic. He recognizes that the biotic factors are jointly related to these two in their effects. It is logical to believe that trees, by the nature of their growth, more completely utilize the entire soil mass and therefore are better indicators of site conditions than is ground vegetation. The relationship between ground vegetation and the type of forest cover is illustrated by the fact that hardwood forests produce litter high in bases and low in resins whereas conifers produce litter low in bases and high in resins. The former promotes rapid conversion of organic nitrogen to available forms, and the fixation of atmospheric nitrogen, whereas the latter is associated with incomplete conversion of organic nitrogen and a paucity of nitrogen fixation. Classification of forest sites should be based on fundamental and permanent features of site, namely soil and relative topographic position of the soil mass. In such a classification the following characteristics of site should be considered: 1. Aspect. 2. Relative topographic position and slope. 3. Texture and thickness of the surface soil, or A horizon. 4. Texture and thickness of the B horizon. 5. Nature of the substratum or soil parent material and its depth if relatively shallow. The classification should be supported by investigations on the relationships between tree growth and forest cover type occurrence and the site factors mentioned.

Coile (7) studied the relation of site index for shortleaf pine in the Duke Forest of North Carolina and certain physical properties of the soil. Forty-eight pure, even-aged, old-field stands were observed, twelve of which were included among those for which laboratory measurements of soil characteristics were made. Soil factors measured were, thickness of the different soil horizons, complete mechanical analyses of each horizon, soil porosity, water absorption capacity in the natural state, and volume-weight ratios. No definite correlation was observed between site index and any one physical characteristic or component of any one horizon. A texture-depth index was developed which proved to be a reliable indicator of site index. This index is obtained by dividing the silt and clay content, or the colloidal content (the former is the better), in percent, of the B_1 horizon, by the average depth in inches below the surface at which that horizon is encountered. It is indicated that site index can be estimated in broad classes in the field by soil borings to determine the depth to the B_1 horizon and to estimate the silt plus clay percent. Mechanical analyses are desirable to check the estimations of silt and clay content. Some general correlations of site index with composition of the understory were noted and have been summarized.

Coile (8) studied the relation between certain physical properties of the soil and topographic-position classes and site index of loblolly pine and shortleaf pine in the lower Piedmont region of North Carolina. He indicates that "the usefulness of quantitative demonstrations of the correlations between essentially permanent

features of the soil and such things as site index, volume yield, response to cutting, establishment of reproduction, the rate and direction of forest succession, stand composition, and the survival and growth of plantations is readily apparent to most foresters engaged in land management". The study was based on 151 sample plots including 27 different soil types and 21 soil series. The data were analyzed by regression methods. A total of 9 soil variables were tested for significant correlations with site index. Those contributing significantly to site index of each species were: X_1, thickness of the A horizon or surface soil in inches; X_2, ratio of silt-plus-clay to moisture equivalent of the B horizon; X_4, the second power of X_2; and X_9, the imbibitional water value of the B horizon or subsoil. Soil variables which did not contribute significantly to site index were: X_3, product of X_1 and X_2; X_5, product of X_1 and X_4; X_6, total depth to the C horizon in inches; X_7, product of X_2 and X_6; and X_8, product of X_4 and X_6. Regression equations with 4 significant variables are given for both loblolly and shortleaf pine. In order to simplify the equations for practical use two of the variables were dropped. Almost as accurate estimations of site index can be obtained with the remaining two variables and only one laboratory measurement of soil physical properties is needed. The two regression equations presented for use are as follows:

$$YL = 100.04 - \frac{75}{X_1} - 1.39\ X_9$$

$$YS = 77.32 - \frac{45}{X_1} - 1.00\ X_9$$

in which YL is the site index for loblolly pine and YS for shortleaf pine, X_1 is the thickness of the A horizon or surface soil in inches, and X_9 is the imbibitional water value of the B horizon or subsoil. A very practicable method of using this information in the field has also been developed and presented. A total of 245 separate determinations were made of the imbibitional water values of 31 soil series (or variations of the series) recognizable in the field. The mean and parameter of this measurement for each series was determined and is given. The series were then classified into 9 groups each showing an average value for imbibitional water sufficiently different from any other group as to be used as an index. The field man need only to determine the depth of the A horizon and recognize the soil series in the field. The imbibitional water value of the B horizon for the site is obtained from a table and, with it, and the depth of the A horizon the site index is available for either pine from tables. The site index of loblolly pine was consistently higher than that of shortleaf pine the standard error of the difference being 0.13 ± 0.0249. This was very significant.

Coile (9) summarizes 10 years of work carried on in the southeast concerning soil productivity for different trees common to that area. Species included are: loblolly, shortleaf, longleaf, slash and pond pine. The work of a number of graduate students has been included and credited. This summary is intended for immediate practical application of the findings in forestry. The area concerned has been classified into three general zones and the findings presented by species. The zones are: 1. The Piedmont region of North Carolina to Alabama. 2. The northern portion of the Southeastern Coastal Plain including Virginia, North Carolina and

northeastern South Carolina. 3. The southern portion of the Southeastern Coastal Plain including South Carolina, Georgia, Florida and Alabama. Coile states that properties of the environment which affects the rate of tree growth are those which define or limit the amount and quality of growing space for tree roots. Examples of these properties are: depth or thickness of surface soil, depth to mottling, texture or consistence of the subsoil, surface drainage and amount of incorporated organic matter. Tables and figures are presented in which these properties, once determined, make it possible for foresters or technicians to estimate the site index for the various species concerned. The only equipment indicated as being needed is a soil auger. Some training is necessary and information is given to assist in training.

Coile (10) studied the relationships between soil features and species composition and density of hardwood understories in loblolly and shortleaf pine stands. The practical application of positive results would include the allocation of land areas into different classes for regeneration treatments based on expected type and density of competing cover. The study is a further analysis of data obtained from an earlier investigation (8) of effects of soil characteristics on site index of loblolly and shortleaf pine in the Lower Piedmont Plateau Region of North Carolina. The procedure included the collection of information on the amount of growing space occupied by the various species of both over and understory. Using this measure as the dependent variable (Y) for different major species, a study was made by multiple regression analysis, of the effects of certain independent variables

such as: (X_1) depth of surface soil in inches, (X_9) imbibitional water value of the subsoil, (S.I.) site quality of the land for pines, texture of the surface soil classified into "coarse", "medium", and "fine", and age of the species being studied. Regression equations have been developed for the three textural classes of surface soil for dogwood, redgum and red cedar. Charts are presented showing the relationships of these factors plotting stocking rate over age for each species. No significant relationships were found to exist between the independent variables and stocking of the so-called "dry-site" oaks but an equation and relationships are given for the "moist-site" oaks in which density of the pines was important. No significant relationships were found to correlate with stocking of hickories, yellowpoplar, or other hardwoods. The species whose stocking is significantly affected by permanent mappable soil characteristics alone comprise 70% of the total understory of the average pine stand. From the author's report and discussions one would conclude that the independent variables did not include the most limiting factors affecting density of those species showing no significant relationships. If one could find some characteristic(s) of the environment not correlated with site quality for the overstory but showing positive correlation with density and growth of the important understory he would more nearly accomplish the objectives of a study like that attempted by Coile. This may be an impossible situation assuming that competition of plants for water, nutrients and light are the basic factors governing competition.

Einspahr and McComb (12) have studied site index of oak in northeastern Iowa with respect to soil series, soil profile characteristics and topography. The studies included 108 site index plots and

16 volume plots. They found soil depth, topographic position, aspect, percent of slope and certain physical properties of the soil were related to site index. Ten soil series and land types were included with the conclusions that certain major soil characteristics, used in describing and defining them, satisfactorily correlated with site index. The average site index values for oak and pine on these series are given with some discussions. Total horizon thickness or the average depth of soil material to unconsolidated or consolidated bed rock or to tight subsoil showed a highly significant correlation with site index. Equations have been developed for, north and east aspects, and for, south and west aspects, which best estimate these relationships. North and east aspects were found to have higher site values than south and west aspects. Differences in site index due to upper, middle and lower slope positions were confounded with differences in soil depth and a complete picture was not reflected by the data. The authors indicate that noted differences were caused by related factors affecting total available moisture. Site index values decreased with an increase in slope percent. This relationship was not statistically significant for north and east aspects but was highly significant for south and west aspects. Some information on stand composition and total volume of production is included for both oak and pine as influenced by differences in soils.

The Forest Service (13) reports some of the findings of Carmean from an unpublished manuscript "Physical characteristics of four forest soils of the douglas fir region of southwestern Washington". Factors showing a close relationship to site index are: 1. effective

rooting depth, 2. content of gravel, 3. available content of capallary moisture, and 4. relation of capallary to non-capallary pore space.

Gaiser (14) reports studies relating soil characteristics and site index of loblolly pine in the Coastal Plain Region of Virginia and the Carolinas. His study is based on 202 plots established in well-stocked, even-aged stands whose minimum age was 28 years. Information was recorded by soil horizons on texture, structure, consistency, color and mottling. The depth of different horizons was determined. Laboratory determinations were made of the moisture and xylene equivalents and from that the imbibitional water values were calculated. The plots were classified on the basis of surface drainage into well drained, imperfectly drained and poorly drained soils. Statistical analyses were completed by correlation methods using depth to the least permeable horizon and imbibitional water value of the least permeable subsoil horizon as variables. These were transformed into logarithmic functions and added or subtracted to form a single coded expression for analysis. Site index curves were developed from the data by the site index equation and compared with published growth curves. Only slight difference was evidenced but site index curves developed in this study were used for the analysis. It was found that site index was described by three equations, one for good and imperfectly drained soils, a second for poorly drained soils with plastic subsoil and a third for poorly drained soils with a friable subsoil. Site index curves for these three surface-drainage classes were all of the same form except the values for the poorly surface-drained soils were higher than those for imperfectly drained which

in turn were higher than for the well drained surface soils. By means of the equations some tables have been prepared which makes it possible for the practicing forester to obtain the average site index for various forest sites. This information is based on the three drainage classes, soil series and depth groups to the least permeable horizon.

Gessel and Lloyd (15) report a douglas fir site-soils survey in northwestern Washington. A total of 186 stands were measured with respect to height-age relationships. Site indexes were obtained from published growth curves. Concurrently soils and climatic information representing the sites were recorded. Soils were described by mapping units established and in use in the area by the Soil Conservation Service. Annual precipitation was obtained from a carefully prepared isohyetal map. All stands were below 800 feet in elevation. The average site index for each mapping unit was determined and its parameter calculated. This information is summarized for ready reference and use. It was found that site index on all soils examined increased with change in texture from coarse to light to medium. No heavy-textured soils were included. Depth of soil was an important factor influencing site index for soils underlain by a hardpan or by bedrock. Mean annual precipitation was found to be related to site index on similar profile and textural groups.

Haig (17) studied the effect of colloidal content of the A, B, and C horizons and the silt-plus-clay content of the A horizon on site index of red pine in southern Connecticut. The study was based on 95 plots from which site indexes and soil values were

obtained. The information was analyzed by regression methods. He found definite correlations between these soil values and site indexes, those for the A horizon being better than those for either B or C or combinations of all three layers. No reliable correlations were found between measurements on organic matter, soil fertility, and reaction pH and site index. He indicates that site index cannot be accurately estimated from present data on soil types but that a knowledge of textural quality of the A horizon permits a classification within one broad site class.

As summarized by Coile (7) "Hicock et al (18), related certain soil characters to the growth of young red pine (P. resinosa Soln.) planations in Connecticut. The stands ranged in age from 12 to 30 years. They found that the character of the subsoil did not have a controlling influence on the site index, but state that 'as the trees became larger, the character of the subsoil may exert greater influence'. In their study the silt and clay content of the A horizon, above 20 to 25 percent, showed no correlation with site index. Colloidal content exhibited only a slight correlation. They found a positive correlation between the moisture equivalent of the A horizon and the site index. In general, they observed fairly good correlations between low site values and low values of the factors in question."

Hill et al (19) working in Lewis County of southwestern Washington on douglas fir reports methods of correlating soils with site quality. A total of 148 stands were measured to determine the site indexes from published growth curves. Concurrently information about the soil, topography and climate was recorded. The data were

classified and studied on the basis of soil series and type, soil mapping units used by the Soil Conservation Service in that area, and on the basis of a land-use capability classification developed and used by the same organization. Soil series and type alone did not give a satisfactory correlation with site index although proper groupings of these types made correlation possible. Excellent correlations between production and site quality was obtained when mapping units used by the Soil Conservation Service were considered. Site index variations on all but two of the thirteen mapping units included showed variation coefficients less than 7 percent which is considered very close for such work. Since land-use capability classes by definition are generalized categories into which all land is classified for safe, permanent use, they are not a satisfactory basis for indicating a single characteristic such as the productive capacity of the land for timber. The authors state that site quality appears to be determined by the moisture relationships of the soil. Slope did not give a correlation with site index.

Lorenz and Spaeth (20) compare the growth of planted conifers on prairie soils with that shown by published site index curves for the same species. The studies include white pine, Scotch pine, European larch, and Norway spruce. These species were planted in 1871-72 on heavy prairie soil (Drummer clay loam and Flanagan silt loam) at the University of Illinois. The studies cover a 70 year growth period. Height-growth curves by age for these species were plotted over accepted site index curves for comparison. In every case the planted conifers grew near the rate of

site I for the first 20 to 30 years after which growth slowed down until, at the end of 70 years, the growth responded more nearly like site III. It was pointed out that one does not want to use site index curves to indicate future production unless the curves have been developed from measurements which include trees growing on similar sites to that in question. Usually site index curves are developed over the natural range of a species and can't be relied upon to predict results with the species planted outside this range. In the case of exotic plants, site index curves can be developed accurately if a sufficient amount of data are obtained which represents the planted area and if the full range of age to maturity is included.

Lunt (21) studied soil characteristics, topography and lesser vegetation in relation to site quality of second-growth oak stands in Connecticut. His studies included seventy-six temporary plots of even-aged second-growth oak well distributed throughout the state. The principal species were white, red, black, scarlet and chestnut oak. Site indexes were obtained by the usual method of measuring average heights and ages and referring to published growth curves. Various factors were studied with respect to site indexes for the purpose of establishing correlations. Soils were examined only to a depth of 5 inches. Results are summarized as follows: When all plots were considered there was either no correlation or a slightly inverse one between site index and surface soil characteristics. When 11 of the plots showing obvious external influences of water table or seepage were omitted, the tendency for an inverse correlation disappeared and a significant

positive correlation was shown between site index and total nitrogen. No correlation was shown between site index and soil series groups. Highest site indexes were shown for plots having a mull condition whereas those with fibrous-mor-over-podzol were lowest. Topography was of little consequence in establishing site index levels except that the author indicates that an obvious advantage for tree growth exists at the foot of slopes as compared with that on the hilltops. Level well-drained areas were slightly superior to level poorly-drained areas for the growth of oak. Site index was inversely correlated with the presence of Vaccinium and Gaylussacia, the mosses, and, to a certain extent, with witch-hazel. There was evidence of a direct correlation with the presence of Rubus.

Pearson (25) studied the height growth of western yellow pine in northern Arizona with respect to spring precipitation and other climatic factors. He found that the height growth of this species is made in the spring and summer during the annual period of least precipitation. Tree activity during this period is almost entirely dependent upon moisture stored in the soil during the winter months from December to March. In seasons when precipitation is supplemented by 2 inches or more during April and May pronounced stimulation in height growth results. Rarely is there June precipitation of any consequence. This supplemental precipitation is several times as effective as the same amount in excess of normal in the period from December 1 to March 31. Factors reflecting atmospheric moisture conditions from April 1 to June 30 show a close but not entirely consistent

relation to height growth. Temperature relationships are important as they affect moisture conditions but, if moisture is abundant, height growth increases directly with temperature. Pearson suggests that a closer relation would probably be shown between soil moisture and height growth than between spring precipitation and height but he recognizes the lack of satisfactory records on soil moisture to develop this correlation.

Ralston (27) reports work on longleaf pine in the Atlantic Coastal Plain area of the southeast. His study is part of a larger project directed by Professors Coile and Schumacher of Duke University dealing with site index, growth and yield of southern pines. Three hundred three areas were examined. Average height and age of dominant trees were measured, soil profiles were described and identified and samples were taken from each horizon. Laboratory analyses of the samples provided information about moisture equivalent, xylene equivalent, and silt-plus-clay content of the subsoil. Statistical analysis by regression methods indicated that age of stand, moisture equivalent of the "B" horizon, depth to mottling, stand density, turpentining, and latitudinal distribution were significantly related to height growth of longleaf pine. A rapid field method of determining site quality is discussed which includes field identification of such things as textural grade of the subsoil and depth to mottling. Site index is then determined by reference to tables and charts.

Storie and Wieslander (31) studied 163 field locations in California to determine relationships of soil, climate and timber site quality. Classes have been established for high, medium,

and low producing sites showing the site index and wood production ranges for ponderosa pine, douglas fir, redwood, and five different kinds of mixed conifers. Actual statistical correlations of production with environmental factors were not made but study of the data has resulted in classifying the several factors so that a soils rating chart could be developed. Factors thought to be most important were: (a) Soil depth-texture characteristics. Soils have been recognized in even foot depth-texture groups from less than 1 foot up to 4 feet and more. (b) Soil permeability. (c) Chemical properties of the soil such as alkalinity, salinity, etc. (d) Drainage and runoff. (e) Climate which is first classified into four commonly accepted zones and rated on a scale for each zone. A range of values in percent has been assigned each of these factors for rating purposes. The product of the ratings for each of the factors (a) through (e) gives the final rating of any site for timber.

Tarrant (32) reports the results of studies about soil fertility measurements through laboratory techniques as they relate to tree growth. This represents one phase of a larger study dealing with site classification and physical site factors for the douglas fir region of the Pacific Northwest. "No statistically significant relations were found between site class and values obtained from determinations of soil reaction, silt-plus-clay content, total nitrogen, available phosphorus and potash, base exchange capacity, replaceable calcium and magnesium, and organic matter. In general, the nutrient content of forest soils in the Douglas-fir region appears to be too high to constitute a limiting factor in tree growth."

Turner (33) has developed an elaborate key to forest types and subtypes for the southeast based on soil and topographic features thought to be of importance in limiting composition and distribution. He has drawn on many sources for information. Much experience, judgment and observation has gone into the development of his key. He states that there is an obvious relationship between rate of height growth of trees and recognizable quantitative group combinations of factors such as are summarized in a specific soil type of specific slope and exposure. An even more obvious relationship exists between rate of height growth and specific soil profile characteristics. He recognizes that soil features influencing available water are the important factors determining the rate of growth of trees. The key first uses major land-forms as a primary breakdown i.e. -- large river floodplains, coastal plain region, Crowley's ridge, and Ozark and Ouachita mountains. Less important land-forms appear to provide the secondary breakdown in the key and they include the following: first bottoms; second bottoms (terraces); small and medium-sized stream floodplains; coastal plain terraces; rolling coastal plain soils; ridgetops and south, east, and west slopes; and north slopes, ravines, deep gullys and coves. Finally a tertiary breakdown is provided which uses combinations of criteria such as drainage, soil profile differences and soil series and types.

Westveld (35) reports work in northern Michigan related to soil characteristics, forest growth and composition in northern hardwood forests. His work was with mixed, all-aged stands in which sugar maple appeared to be the dominant species. After sufficient

study for verification he used average total height of the dominant mixed stand as the basis for segregating plots into site index classes. There was little difference in results when the average total height of the dominant sugar maple portion of the stand was used as the basis. Spread in site index among the 87 plots studied was from 67 to 95 feet. This is a relatively narrow range as compared with other species. It indicates the need of more specialized environmental conditions for this type of forest than for some species of conifers such as douglas fir which has a site index range of from 80 to 210 feet. The plots appeared to fall into three natural site index classes which were arbitrarily set up as 70, 80, and 90 feet. There was a wide range in soil textures among the 23 recognized soil types studied. Although it was indicated that differences in composition and growth were sufficient on the different soil types to form recognizable classes the differences were best brought out when the soil types were grouped on the basis of similarities of surface and sub-soils. Seven such soil groups were developed and data appeared adequate to set forth quite definite conclusions about forest growth on five of them. Tables are given to show the average site index of each soil type in each of these groups. On the basis of the studies many other soil types not specifically included in the studies have been added to the groups with the assumption that tree growth on them will be similar.

METHODS AND PROCEDURE

Information reported applies to the entire Willamette Basin below an elevation of about 2000 feet. This includes all of the area drained by the Willamette River and its tributaries.*

The study included only one species, douglas fir, Pseudotsuga taxifolia (Poir.) Britt. (16). It is by far the most important timber producing species in the area and information about it commanded first priority.

Measurements of forest production. The ratio of average height to average age of dominant and codominant trees in normal even-age unmanaged stands was accepted as the most usable guide for measuring forest productivity. This ratio at 100 years of age is known as the site index for douglas fir. Yield tables have been developed for different site-quality classes and are in general use (22). "Normal" stocking implies stands having ideal or the most effective number and distribution of trees (22). "Unmanaged" stands implies those where such things as thinning, pruning, excessive use by livestock, etc. have not been important in determining the height-age

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* Regression analyses of data obtained on residual hill soils include the following distribution of plots by elevation zones: 0--1000 feet 130 plots, 1001--2000 feet 38 plots, 2001--3000 feet 3 plots. Enough data are available to make the information reliable below about 2000 feet. Climatic influences on tree growth above this elevation may differ from those at lower elevations both on the east and west of the valley. Such influences may not be reflected in the variables studied in regression. For instance coastal influences may affect growth at the higher elevations on the west side of the valley whereas the incidence of rainfall may influence it on the east. For that reason it is thought best to limit the applicability of the present work to areas in the Willamette Valley below the 2000 foot level until more data can be obtained for areas above this zone. The area below 2000 feet covers the majority of small private holdings which are most important from the standpoint of Soil Conservation Service functions.

relationship. Individual trees in "even-age" stands (4) seldom varied more than 10 years and usually the variation was within 5 years. Production capacity of every site studied was obtained by measuring the height and age of 5 selected dominant and codominant trees in each forest and obtaining the average. In case wide variation existed between the ages and/or heights, additional trees were measured to give a better average. Seldom was it necessary to measure more than 10 trees.

Tree heights were measured by three different methods, the one used on any plot being selected at the discretion and convenience of the technicians. The Abney hand level was used in the first two methods to determine angles, in percent, from some convenient point, to the base and to the top of each tree. One method used horizontal distance to the base of the tree from the point of observation whereas the second used the slope distance (4), (23). A third method used the angles, in percent, to the base, to the top, and to a point 10 feet above the base of the tree as determined by careful Abney level readings and a 10 foot measuring rod. A simple formula was worked out and a table developed for quick conversion of these measurements into tree height. This eliminated the time consuming and laborious job of determining either the horizontal or slope distance to the tree from the point of observation. Many checks were made on accuracy of the various methods and it was found that careful work would give the required accuracy of height measurement from either method. The last method, being much more convenient and faster, was used on a majority of the plots.

Age of trees was measured by increment borings. These were taken at breast height and a standard figure of 5 years added to each measurement to correct for this height. A slightly more accurate method of correcting for breast-height borings by different site classes could have been used but it was not deemed sufficiently important to justify complication of the procedure (22).

In selecting forest plots for study careful consideration was given to the stand before finally accepting it. Normal stocking, as described above, was the first major consideration. A range of normality was, of course, necessary and anything that did not meet this rigid screening was not accepted as measurable. General remarks were always made concerning unimportant variations from normality which sometimes were allowed. Snow injury and breakage were soon found to be an important factor which materially affected the height-age relationship of stands. Whenever it was recognized the plot was passed up. Occasionally it was overlooked in the earlier plots but field checking of plots which did not conform to a general pattern corrected these errors. In order to get the required representation of plots throughout the whole basin it was necessary to accept some cutting, livestock use, etc. on plots measured. Careful study of periodic growth rates from the increment cores, comparisons with like plots already measured, and other general observations indicated in these cases that no important errors existed because of these uncontrolled (anthropeic) factors.

Cateclysmic and biotic influences of fire, flood, insects, fungi and animals were avoided whenever possible in selecting stands for measurement. It was generally impossible to ascertain

the influence of these factors on the height-age relationship of stands because symptoms may have been obliterated by the years. Whenever evidence cast doubt upon the suitability of a stand in these respects the plot was not measured.

General information about associated species, amount of brush and ground cover was recorded for each plot as it was helpful in calling to mind the factors indicative of normal even-aged unmanaged stands. This information was also very useful in field checking plots which did not seem to conform to a norm.

Measurements of land and climatic factors. Permanent mappable land factors obtained concurrently with the forest production information for the purpose of correlation fall into three classes, soils (edaphic factors), topography (physiographic factors) and climate (climatic factors).

Soil was examined by auger and/or pit to obtain accurate representative information for the plot (30). Effective depth was measured to a total of 60 inches or to the limit of satisfactory root and moisture penetration whichever was reached first. Depths to the bottom of each layer thought to have significantly different permeability was also determined and recorded. Textural class was determined for each layer by field methods of wetting and rubbing between the fingers. This information was recorded and the texture of the surface soil given a generalized group symbol in addition. Permeability of each layer beneath the top soil was determined through field inspection by an experienced soil scientist and each layer assigned to a permeability class (24), (34). Kind of underlying material was determined and indicated by symbol.

Soil Series as published by the Bureau of Plant Industry, Soils and Agricultural Engineering was recorded for each plot (26). Presence of stones or gravel in the topsoil sufficient to modify the texture or management was recorded. General information about structure, color, mottling, presence of roots, etc. was recorded and sometimes diagrammed to assist in interpretation. Soil examination and measurements were those used as standard by the Soil Conservation Service except that a little more detail was included such as indicating actual depths instead of depth groups. The information was coded as much as possible in accordance with national standards (30).

Topographic features recorded for each plot were: 1. Average slope in percent. 2. Aspect which was taken as the average perpendicular direction away from the slope recorded in degrees azimuth or as one of 12 arcs of the compass such as NNE, NE, ENE, ESE, SE, SSE, SSW, SW, WSW, WNW, NW, or NNW. Magnetic declination was set off at 22 degrees on compasses used. In the case of ridgetop positions the aspect was read down the ridge. In some cases aspect was not deemed important in establishing the site quality in which case it was indicated as X. These cases were usually on slopes of less than 3 percent. 3. Position on the slope was recorded under one of four different classes, either X which occurred on almost level land and accompanied an X designation for aspect; L representing lower slopes, bottom or valley areas where hills or mountains in the immediate vicinity may significantly influence tree growth by affecting climate or moisture relationships within the soil; M representing midslope positions; and U representing upperslopes and

ridgetops where topography may influence tree growth significantly due mainly to wind action and indirect effects. The approximate length of slope as indicated by casual observations from the plot area was recorded to help determine validity of the position effect. 4. Elevation was recorded for each plot by means of a surveyors barometer or by using available topographic maps.

Climatic factors affecting each plot were generally homogeneous because the study area was confined to the Willamette River basin. Climatic differences due to elevation were accounted for by recording elevation and using it in the analyses. Seasonal influences and cycles are averaged when long-lived perennial plants such as trees are studied. Differences in average total annual precipitation and average seasonal precipitation (6 months period from April thru September) were thought to offer some promise as additional factors for correlation with forest production. Accordingly this information was determined for each plot from isohyetal maps.*

Field work. Field work was done mostly by crews of two men, a soil scientist and forester, or two soil scientists. Passable roads throughout the area were traveled, spotting what seemed to be suitable stands within easy walking distance. As stands were found they were measured providing close inspection indicated that they were suitable. If they were questionable they were passed up. An attempt was made to locate plots several miles apart to get complete and adequate coverage of the whole Willamette Basin.

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* Map showing warm-season precipitation for Oregon was taken from Climate and Man, U. S. Dept. Agric. Yearbook, 1941 and superimposed to scale over an isohyetal map of total annual precipitation in the Willamette Basin. The latter was provided by the Corps of Engineers, U. S. Army, Office of the District Engineer, Portland, Oregon.

Among the records made for each plot were the general location of each, according to some roadmarker, and the legal description, to the nearest quarter-quarter section. Occasionally one or more trees were marked with a temporary tag to facilitate relocation if necessary. All measured plots were plotted by legal description on a master map in the office so that the precipitation information could be easily obtained by reference to the isohyetal map and so that the distribution throughout the entire basin could be more readily known and controlled.

All information was accumulated on record cards especially designed for this purpose. As data for plots accumulated, the site indexes, obtained from existing growth curves or tables (22), were summarized by soil depth and slope groups and by Soil Series recognized by the Bureau of Plant Industry, Soils and Agricultural Engineering. These tentative summaries were used to guide the work and to spot outstanding discrepancies. Widely variable results called for field checking. Quite frequently the original information was changed by a careful study during field checking. In most cases reexamination brought the information more in line with the apparent norm. Occasionally reexamination merely substantiated the original records in which case the information was used in the analyses. Some plots were rejected after checking because it was apparent that they were not representative or because evidence was available to indicate that they may have been influenced by some of the environmental factors which were uncontrollable. In all some 89 plots were field checked. Table 1 gives a chronological list of all plots included

in the study. Following is a summary of the plots showing, in total, the number which were rejected and how the usable ones are distributed among soil series.

Total number of plots ---------- 310

Total number of plots rejected:
After field checking ---------- 19
Results questionable but field checking not yet done ---------- 13

32 32

Total number of usable plots represented ---------- 278

These plots were distributed among the different Soil Series as follows:

A. Residual hill soils of major importance in continued forest production.

Olympic	118
Melbourne	34
Aiken	14
Cascade	12
Polk	3
Total	181

B. Other soils: where other potential use is greater than for forest production; where conditions are very poor for forest production; or soils of such small extent in the valley as to be relatively unimportant in forest production.

Amity	5
Camas	10
Carlton	2
Chehalis	4
Clackamas	1
Hillsboro	5
Newberg	4
Powell	28
Salem	16
Salkum	3
Viola	1
Willamette	18
Total	97

Analysis of data. The plots were divided into two general groups for analysis as shown in A and B of the above summary.

The residual hill soils and the Powell Series were investigated by regression analyses. The average height growth of dominant and codominant trees was used as the dependent variable indicative of site quality. Average age, soils, and climatic factors were studied as independent variables. Preliminary study of selected plots indicated linearity existed between the different variables and the logarithm of average tree height. Consequently the fundamental growth curve proposed by Schumacher (28) and employed by Ralston (27) was used. This curve is expressed as follows:

$$Y = b_o + b_1x_1 + b_2x_2 + \ldots\ldots b_kx_k$$

when Y = the logarithm of the average height of dominant and codominant trees in feet, x_1 = the reciprocal of age, $x_2 \ldots\ldots x_k$ represent numerical values for climatic, soil and other site factors studies, and b_o, b_1, $b_2 \ldots\ldots b_k$ are the regression coefficients. If the equation is solved for $x_1 = 0.01$ (age/100) the equation renders the logarithm of the site index.

North aspects were analyzed separately from south aspects. Plots whose azimuth read from 331 to 120 inclusive were classed as "north" whereas those reading from 121 to 330 inclusive were called "south". There were very few plots lying in the "twilight" zones between 285 and 315 and 105 and 135 degrees azimuth and a good representation of north and south aspects as defined was obtained.

All but one of the residual hill soil plots were classed as "medium textured" according to the five generalized textural groups used by the Soil Conservation Service. Surface texture as a variable was therefore eliminated from analysis. Midslope positions (including those marked X, or unimportant) were the only ones represented in sufficient numbers to allow a valid analysis. Plots showing lower and upper slope positions have been summarized (table 14) for analysis later when a sufficient amount of data are available. Complete descriptions of the analyses made on residual hill soils and the Powell Series are referred to later in this report.

Other soils were studied in different ways depending upon their characteristics. In general they were separated by mapping units which in some cases fairly well defined the Soil Series. Where sufficient data were available by depth groups a simple arithmetical average of the site index accompanied by the coefficient of variation represents a satisfactory correlation between timber production potential and mappable land factors. This procedure was followed for all mapping units in this group of soils except for those in the Powell series which was studied by regression analysis in the same way as that for the residual hill soils.

All statistical work followed Snedecor (29). The Doolittle method was found to be least laborious and most reliable in solving normal equations (11). The Doolittle method as given can easily be adapted to solving for the Gauss multipliers by setting each equation up against minus one in much the same way as illustrated by Snedecor and carrying out the instructions as given by Croxton and Cowden (11).

RESULTS

Residual hill soils. These represent the most important soils in the Willamette Valley which will be devoted permanently to forest production. Although nine Soil Series in this group have been recognized, named and published by the Bureau of Plant Industry, Soils and Agricultural Engineering (26), only five were included among the plots measured. The five were Olympic, Aiken, Melbourne, Cascade and Polk. The first four of these are the most important Series from the standpoint of total land area. One plot was measured on the Viola Series but was rejected as being unusable.

Plots measured on the residual hill soils were classified for analysis as follows: Table 2 includes north aspects of midslope position where soils are over 60 inches deep. Table 3 includes north aspects of midslope position where soils are less than 60 inches in depth. One plot showing X, or unimportant, position is included. Table 4 includes level or nearly level aspects all of which were designated as having X, or unimportant, positions. Similarily table 5 lists plots on south aspects of midslope position where soils are over 60 inches in depth. One X, or unimportant, position is included. Table 6 shows plots with south aspects, midslope positions (except two which are indicated as X) and with soils less than 60 inches in depth. All these data have been taken from table 1 which is a chronological list of all plots measured. A summary of the analyses made is shown in table 7. The variables included in each analysis, the number of plots included, the values of each regression coefficient, the values of "t" and the various levels of significance of the coefficients are shown.

Analysis #1 (table 7) included 23 plots of north aspect, midslope position and soils with total effective depth of 60 inches and over. Soil depth was not included as a variable in the regression analysis because no definite numerical values for soil depth were available. Age only proved to be a significant indicator of site index with this group of plots.

Analysis #2 (table 7) was then made using the 21 plots with north aspect, midslope position and soil depth less than 60 inches. Here age and soil depth both proved to be significant.

In order to get a better analysis and determine more accurately the value of other variables, plots included in both analysis #1 and #2 were combined with those representing level aspect (table 4). This gave a total of 71 plots which were included in analysis #3 (table 7). Here both tree age and total effective soil depth again proved to be highly significant but the other variables were not sufficiently important in deciding the site value of an area to be retained. Consequently the best estimation of site index for north and level aspects on medium textured soils with midslope or unimportant positions is expressed by the following equation:

Equation #1:

$$Y = 2.196{,}535 - 13.379{,}077\ X_1 + 0.002\ X_2$$

in which Y is the logarithm of the estimated tree height, X_1 is the reciprocal of age and X_2 is the total effective soil depth in inches. The multiple correlation coefficient of this equation (R) is 0.8991 which indicates that a very high degree of success is attained by estimating the site index of any comparable area by using the equation. When age is held at 100 years the equation renders the site index directly.

Analysis #4 (table 7) included 32 plots of south aspect, midslope position and with soils over 60 inches deep. Again soil depth could not be used as a variable in regression analysis because numerical equivalents of soil depth for each plot were not available. Only tree age proved significant.

Analysis #5 (table 7) including 40 plots, represented south aspect of midslope position with soils under 60 inches in depth. Both soil depth and tree age again proved highly significant but some of the other variables showed interesting tendencies toward significance.

As for the north aspects, all plots for south aspects (tables 5 and 6) were then combined with those for level aspects (table 4) and analysis #6 was made with a total of 99 plots to get a better indication of the effects of all variables studied on site index. Here all variables included were highly significant (above the 1% level) except slope percentage which was significant at about the 5% level, and total warm-season precipitation which was significant at about the 25% level. The latter was eliminated from the equation. The best estimation of site index for south and level aspects of medium textured soils with midslope or unimportant positions is therefore expressed by the following equation:

Equation #2:

$$Y = 2.185,764 - 13.881,570\ X_1 + 0.002,189\ X_2 - 0.000,344\ X_3 - 0.000,023\ X_4 + 0.000,604\ X_5$$

in which X_1 is the reciprocal of age, X_2 is the total effective soil depth in inches, X_3 is the slope in percent, X_4 is the elevation in feet, X_5 is the total annual precipitation in inches, and Y is the logarithm of the estimated tree height. The multiple correlation

coefficient of the equation, (before reducing for variable X_6, total average warm-season precipitation) is 0.9335. This indicates a very high degree of success is obtained by calculating the site index for comparable land conditions by use of the equation. This equation renders the site index directly when solved for age at 100 years.

By the use of these equations it is possible to calculate the effect of any one variable (factor) on site index with all other variables controlled. This has been done and the information is shown in tables and figures.

Table 8 shows estimated site index on north and level aspects as influenced by total effective soil depth. Age was held at 100 years and the values were obtained by solving for Y in equation #1. The average fiducial limits at the 5% level for depths between 18 and 60 inches is ± 9.5 feet.* This information is shown graphically in figure 1.

By a careful study of fig. 1, information is available which will be of value in classifying forest production and soil depth into usable increments for field surveying and application. It is obvious that site index information can be estimated accurately to within about ± 10 feet. Generalized production classes could then be fixed in 20 foot increments. Classes now in general use include essentially a 30 foot increment (22). The average site index, from published growth curves, of all 71 plots included in the data from which figure 1 was calculated is 153. This is near the median of the site

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* Fiducial limits were calculated first for the logarithm of average tree height at 100 years as shown in table 8. The antilogs for the extremes represent the fiducial limits in terms of site index. The average of the median points of these site index extremes has been taken as the "average fiducial limits". This same method was used throughout the report to obtain average fiducial limits in terms of site index.

range for douglas fir as reported by McArdle et al (22) and indicates that the average production in the Willamette Valley lies near the median for the entire range. In setting up production classes for general use by the Soil Conservation Service, using the information available concerning the accuracy of our site index estimations and the knowledge that an index of 153 (or 150 for convenience) is the mid point in the productive range for douglas fir, we have developed the following table to compare site index classes now used and those proposed.

Site Class No's. --	V	IV	III	II	I
Productivity ------	Very low	Low	Moderate	High	Very High
Classification now in use (McArdle et al)					
Class mark ---	85	110	140	170	200
Limits -------	Below 95	96 to 125	126 to 155	156 to 185	186 and up
Proposed classification based on present study					
Class mark ---	110	130	150	170	190
Limits -------	Below 120	121 to 140	141 to 160	161 to 180	181 and up

It is suggested that conservation recommendations (guide sheets, etc.) be based on the proposed new classification because it will allow a maximum use of reliable information available about productive capacity of soils.

Soil depth groups used by the Soil Conservation Service have been standardized. The established depth groups (1--very deep, 60 inches or more; 2--deep, 36 to 60 inches; 3--moderately deep, 20 to 36 inches; 4--shallow, 10 to 20 inches; 5--very shallow, less than 10 inches) do not reflect a linear relationship. The relationships shown in fig. 1 for douglas fir are nearly linear up to the ultimate total depth recorded which was 60 inches. In other words there is as much influence on production per unit of soil depth at 50 or 60 inches as at any point nearer the surface. Had we determined and

recorded total depths above 60 inches it is certain that at some point the trend of site index would have fallen off giving the typical sigmoid relationship found in biological work. To get the full value of total effective soil depth in determining the productive capacity of soils for douglas fir it will be necessary to study this factor to a depth greater than 60 inches.

It is interesting to note that the equation can also be used to help determine the total effective depth of the soil (or the value of any of the other factors included). For instance the surveyor may have difficulty in determining the total effective soil depth on a site because of rocks or because suitable equipment may not be at hand. If a suitable stand of timber exists he may determine the average age and height of dominant and codominant trees, enter them in the equation, (after first converting the average height to its logarithm and the age to its reciprocal) and solve for the total effective soil depth.

Table 9 shows estimated site index on south and level aspects as influenced by total effective soil depth. Age was held at 100 years and all variables except soil depth held at the mean. Estimated site index values (Y) were obtained by solving equation #2. The average fiducial limits at the 5% level for soil depths between 18 and 60 inches are $\pm$ 7.7 feet. This information is shown graphically in figure 2. Since there is very little difference between the relationships of soil depth and site index on north (figure 1) and south (figure 2) aspects the remarks made above about establishing forest production and soil depth groups applies to both north and south aspects.

Table 10 shows site index on south and level aspects as influenced by slope. Age was held at 100 years, all variables except slope were held at the mean, and the values were calculated by using equation #2. The fiducial limits at the 5 percent level are shown. This information is shown graphically in figure 3. The average fiducial range, based on the estimations in table 10, is ± 7.9 feet. There is a gradual diminution in site index as slope increases on south and level aspects. The relationship appears to be strictly linear. The total effect of slope on site index as it changes from 5 to 130 percent amounts to 14.4 points which is about the value of the average fiducial range. Although this factor proved significant above the 5 percent level (table 7) the effect on site index is not sufficient to allow the establishment of slope groups based on differences of production alone. Similar relationships exist at all soil depths as indicated in table 11 and figure 4. Here site index has been calculated from equation #2 holding the age at 100 years, soils at different depths and other variables at the mean. Slope groups have been established primarily to indicate hazards under continued use and other limitations in forest management. Since slope has proved to be a significant factor in establishing site index for any unit of land on south aspects it is suggested that recognition be taken of it when estimating the productive potential of land from the conservation survey. For the purpose of estimating productivity therefore, the following slope groupings are proposed: 20% to include slopes from 0 to 30 percent; 40% to include slopes from 30 to 60 percent; 80% to include slopes from 60 to 100 percent; and 120% to include slopes above 100 percent.

Site index on south and level aspects as influenced by elevation is shown in table 12. This information was calculated by using equation #2. Average age of trees was held at 100 years, all other variables at the mean except elevation which was varied as shown. The average fiducial range shown in these calculations is ± 8.4 feet. This information is shown graphically in figure 5 where a rather steep linear relationship appears to exist indicating a gradual diminution in site index with increase in elevation. There is no definite indication here to help one decide upon elevational groups to establish for the determination of forest production. Perhaps it would be as well to use convenient near-elevation figures taken from topographic maps for any woodland area concerned. If elevational groups are to be developed for use in solving the equation it is suggested that some additional studies be made so that breaks will reflect such things as seasonal logging conditions. Three elevational breaks should be a maximum for the range 300 to 2700 feet covered by the data reported. For the purpose of solving the equation it is suggested that 500 feet be used for sites up to 1000 feet, 1500 used for sites from 1001 to 2000 feet and 2500 be used for sites from 2001 to 3000 feet. Reference is made to a footnote at the beginning of "Methods and Procedure" of this report regarding validity of using the information at elevations above 2000 feet.

The effect of average total annual precipitation on site index for douglas fir growing on south and level aspects is shown in table 13. The information was obtained by solving equation #2. Age was held at 100 years, all other variables held at the mean except precipitation which was varied as shown. The average fiducial limits at the 5

percent level are ± 8.7 feet. This information is shown graphically in figure 6. A linear relationship is indicated showing an increase in site index with increased precipitation. The entire range of precipitation, 30 to 110 inches, covers 27 site index points or about one and one-half times the average fiducial range. Precipitation breaks are therefore needed to indicate a true picture concerning production of douglas fir timber. Information about average annual precipitation is available to the soil surveyor and forest planner in every SCS office through virtue of the Land and Water Inventories and published reports. Precipitation is usually given in increments of 10 inches. It is suggested that precipitation groups for residual hill soils on south aspects in the Willamette Valley be established as follows for the purpose of solving the equation: 45 inches covering the range up to 55 inches, 65 inches including all sites from 56 to 75 inches, 85 inches for sites from 76 to 95 inches and 105 inches for sites above 95 inches.

Table 14 summarized all plots (taken from table 1) which represent upper and lowerslope positions. These are divided between north and south aspects. No attempts have been made to analyze these data for use. Designating a plot as being significantly affected by positional effects common to upper and lower slopes, as defined in this work, is fraught with much chance for error. The only way to establish these facts definitely is through a complete analysis. Because of inherent chances for error in classifying plots into these positional classes a large number of measurements would be necessary before valid analyses and conclusions could be made. For that reason these plots have merely been summarized and are available for later analysis when additional information is obtained.

The Powell soil series. Plots measured on soils of the Powell series appeared to offer an opportunity for correlation analysis, table 15. Accordingly analysis number 7 as summarized in table 7 was carried out. A total of 27 plots were included. This soil series is common in the north end of the Willamette Valley both east and west of the city of Portland. The total annual precipitation range sampled varied from 43 to 67 inches but data for the extremes of this range were so meager that it was thought to be insufficient for valid analysis. For that reason precipitation, both total annual and warm season, were eliminated from the analysis. All plots measured proved to belong to the medium-textured class so surface texture is not considered as a variable on this series. Aspect and position, although recorded for each plot, were not considered as variables in the analysis because of insufficient data or because previous analyses indicated these factors to be of little consequence. Of the four variables included, age, soil depth, slope and elevation, only reciprocal of age (X_1) and total effective soil depth (X_2) were significant. These were significant above the 1 percent level. Accordingly the other two variables were discarded. The best estimation of site index of douglas fir on all aspects of medium surface-textured soils in the Powell series is therefore expressed by the following equation:

Equation #3:

$$Y = 2.173,986 - 12.241,256\ X_1 + .002,115\ X_2$$

in which Y is the logarithm of the estimated tree height, X_1 is the reciprocal of age and X_2 is the total effective soil depth in inches as interpreted by the Soil Conservation Service. The multiple

correlation coefficient for this equation (R) is .8841. This equation renders the site index directly when solved with age held at 100 years.

The influence of total effective soil depth on site index has been studied by use of this equation, table 16, and the relationships shown graphically in figure 7. The relationships are quite similar to those shown for north and south aspects of residual hill soils and the information should be used in the same way as suggested for them.

A comparison between the residual hill soils on north and level aspects, south and level aspects and the Powell soils on all aspects and positions with respect to site index-total soil depth relationships is shown in figure 8.

Miscellaneous soils. There are many more recognizable soils in the Willamette Valley than those represented by the three equations given above. Many of these were originally forested. Some of them are in forest cover today. From the standpoint of total forest production in the future however, they are relatively unimportant because the acreage is either small, the soils are of low site value for timber or they have greater potential uses than for forest production. A number of plots were measured on some of these miscellaneous soils and the information is summarized in table 17. To get usable information about their productive capacity for douglas fir this miscellaneous group was classified by soil Series and depth groups. Mapping units included in each group are shown. The site indexes obtained for the plots were averaged within these groups and, where enough measurements were available, the coefficient

of variation was calculated to give an idea of the range which existed among the measurements. This information has been further summarized in table 18 which makes a convenient reference table for immediate use in estimating productive capacity of any site for douglas fir based on soil survey information. More samples are needed before adequate information is available for all the soils in this group.

Growth curves. Growth curves have been calculated for douglas fir in the Willamette Valley from equations #1, #2, and #3 by holding all variables at the average and solving for Y at different ages. This information is summarized in tables 19, 20 and 21. Points have been calculated covering the range of data on age as reflected in the samples measured except for the 100 year age class in tables 19 and 21. These latter points have been supplied. Points representing these growth curves have been superimposed over the published growth curves of McArdle et al (22) for comparison, figure 9. The similarity in shape and magnitude is remarkable. The weighted average site index at 100 years as calculated by the equations developed in this study is 144 whereas McArdle shows a site index of 140 feet at 100 years. If one were to connect the points determined by the equations, figure 9, by a single generalized line, the curve thus formed would fall about 4 feet above McArdle's Site Quality III curve throughout.

PRACTICAL APPLICATION OF THE INFORMATION OBTAINED

There are three principal uses for the information obtained in this study. These uses are immediately relevent to the work of the Soil Conservation Service. They are: 1. Mapping Units. The figures and discussions will help in establishing valid mapping units for timber land in the area covered by the study. These units will reflect the important permanent factors of land and climate which must be recognized and mapped. It will help eliminate the accumulation of information during a soil survey which will serve no useful purpose in the foreseeable future. This will make surveys less costly, and more simple in interpretation and use. 2. Land Classification. With soil surveys more adequately reflecting important permanent factors for plant growth it will be possible to classify land more accurately on the basis of limitations and hazards under continued permanent use. This study will provide the information about limitations in forest production for any unit of land in the area covered. 3. Land Treatment Recommendations. The Soil Conservation Service, and other agencies, are anxious to provide the best possible recommendations of a practicable nature so that "every acre will be producing in accordance with its capabilities and will be treated according to its needs". Practicable recommendations must be conditioned by the ability of the land owner to operate at a profit level which will sustain his enterprise. This matter of economics varies with the times but it always depends in part on the productive potential of the land on which the owner relies. Land treatment recommendations can be developed with full regard to

the economy of the land owner when productive potential and such other factors as operating costs are known. This study provides the former for douglas fir for the area concerned.

In order to make the information more readily usable by field technicians, especially for carrying out uses under items 2 and 3 mentioned above, a key has been developed by which the site index for any unit of land covered by the study can be obtained from curves and/or a table. Productive capacity in terms of board feet, cubic feet, or any other measure can then easily be obtained from published yield tables for douglas fir. More accuracy can be obtained in estimating site index by interpolating between curves. Direct solution of the equations for variables concerned will give still more accuracy and a nomograph is being prepared for the solution of equation #2 which may replace figures 10 through 17 in the key. It is suggested that this key, the charts and table referred to in the key, together with some simple instructions be taken from this report and placed in the official pocket handbook or some other kind of field handbook for use by technicians needing the information. The key follows:

KEY FOR ESTIMATING SITE INDEX OF DOUGLAS FIR ON LAND IN THE WILLAMETTE VALLEY FROM CONSERVATION SURVEY INFORMATION*

I. Residual hill soils, specifically the Olympic, Aiken, Melbourne, Cascade, and Polk Series -- medium textured soils only.

A. All north and level aspects ---------- Figure #1a

B. All south aspects.

1. Elevations up to 1000 feet.
   a. Average total annual precipitation less than 55 inches ---------- Figure #10
   b. Average total annual precipitation between 56 and 75 inches ---------- Figure #11
   c. Average total annual precipitation between 76 and 95 inches ---------- Figure #12
   d. Average total annual precipitation over 95 inches ---------- Figure #13

2. Elevations from 1001 to 2000 feet.
   a. Precipitation less than 55 inches -- Figure #14
   b. Precipitation between 56 and 75 inches ---------- Figure #15
   c. Precipitation between 76 and 95 inches ---------- Figure #16
   d. Precipitation over 95 inches ------- Figure #17

II. On the Powell Soil Series -- medium textured soils only.

A. All aspects ---------- Figure #7a

III. Other soils ---------- Table #18

IV. Light and heavy textured soils and soils not covered by the above.

These will not be important from the standpoint of large-scale permanent forest production. Where they occur and if site index information is needed it should be determined in the field (if possible) or a figure may be supplied by interpolation from the information given above and from general knowledge of soils.

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* Instructions --. From the key determine the figure or table to consult. Determine the most applicable total effective soil depth from the survey and find the site index corresponding to it from the curve. In the case of south aspects on residual hill soils the proper slope curve must be selected in the figure (or slopes other than those shown may be interpolated from the figure).

ADDITIONAL WORK

Some additional information and analyses would provide greater reliability and simplification in estimating site index for douglas fir in the Willamette Valley. Several items can be mentioned specifically.

1. Influence of total effective soil depths over 60 inches. The plots with deep soil showing high site indexes should be re-examined to establish true values for soil depths over 60 inches. Re-analysis of the data would then show more completely the effects of this factor on tree growth.

2. Elevational limits of the study. Additional measurements should be made on areas above 2000 feet to establish a more satisfactory and complete coverage of the Willamette Basin. It is quite likely that one may get into another climatic zone above this elevation, such zone not being fully reflected by the variables studied. Additional information would then lead to a definition of such a zone boundary after which the productive capacity of the land for timber could be worked out in a separate study from that of the present one.

3. Use of one equation instead of three. All three equation lines fall within the confidence bands set up for any one or all three, figure 8. Accordingly, one could assume that any one of the three equations could be used to estimate site index for any area covered by them. Some accuracy may be sacrificed but statistically this would not be significant above the 5 percent level. Instead of using any one of the three equations reported, a better equation could be obtained by recalculating the regression after combining the data included originally in the separate equations.

If item 3 is done it is suggested that additional information resulting from further work under items 1 and 2 be included and considered at the same time. Furthermore, information in table 14 should also be included. In this case one would be ignoring the possible effects of upper and lower slope positions.

SUMMARY

Land owners and technicians need a reliable method of estimating the productive capacity of land for timber irrespective of the present plant cover. To meet this need in the Willamette Valley, site quality for douglas fir was studied in relation to land and climatic factors on 310 selected plots representing even-aged, normally stocked, unmanaged stands. Production of timber was obtained in the usual manner by determining average age and height of the dominant and codominant trees on each plot. Land and climatic factors studied were: total effective soil depth; textural class of the surface and subsequent soil layers; relative permeability class of each soil layer; kind of underlying material; percent slope; aspect; position; drainage; elevation; total annual; and total warm-season precipitation. These factors are considered to be easily recognizable, measurable and mappable by standard field methods ordinarily used in a soil survey or are available from some other convenient source.

Plots were allocated to three groups for summary and analyses: 1. Residual hill soils which were further separated into north, south and level aspects. 2. The Powell soil series. 3. Other miscellaneous soils potentially less important in future permanent forest production than group 1 and 2. The first two classes were studied by multiple regression analyses, the third by classification into soil Series and depth groups. The studies have resulted in the development of three regression equations which may be used to estimate site index from land and climatic measurements, and a summary table giving average site index (average height at 100 years) and coefficients of variation for miscellaneous soils.

The regression equations to be used in determining site quality are as follows:

Equation #1. Residual hill soils including both north and level aspects.

$$Y = 2.196,535 - 13.379,077\ X_1 + .002\ X_2$$

Equation #2. Residual hill soils including both south and level aspects.

$$Y = 2.185,764 - 13.881,570\ X_1 + .002,189\ X_2 - .000,344\ X_3 - .000,023\ X_4 + .000,604\ X_5$$

Equation #3. The Powell Soil Series.

$$Y = 2.173,986 - 12.241,256\ X_1 + .002,115\ X_2$$

In the above 3 equations Y is the logarithm of average tree height in feet, X_1 is the reciprocal of average tree age in years, X_2 is the total effective soil depth in inches, X_3 is the slope in percent, X_4 is the elevation in feet, and X_5 is the average total annual precipitation in inches. The variables shown in the equations were significant above the 5 percent level. Variables having lesser significance were eliminated from the equations or were not studied in the analyses. The correlation coefficients (R) were .8991, .9335, and .8841 for the three equations respectively.

By the use of these equations each variable tested was studied with respect to its effects on site index independent of all other factors. Tables, figures and discussions are presented. The discussions include suggestions to be considered in developing mapping units for the conservation survey, and in developing site index classes for use in generalized land-treatment recommendations.

Total effective soil depth was the most important factor (except age) in determining the productive capacity of a site for douglas fir timber. This factor appears to gain its importance through the internal water relationships of the profile as they influence plant growth.

A key, a table, and several curves are presented which provide a simple means for the technician to determine site index for douglas fir from conservation survey and other readily available information. This applies to any parcel of land in the Willamette Valley below 2000 feet in elevation.

Some suggestions are given concerning additional work which will provide greater reliability and simplification in estimating site index for douglas fir in the Willamette Valley.

A summary of pertinent literature is included in the report.

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TABLE 1. Chronological list of all plots measured.

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
1	1 mi. SW Silverton SW¼NE¼S4T7SR1W	Willamette	CL	1M3¼	60	4	SW	X	150	60	110	140
2	5 mi. SW Silverton SW¼NE¼S6T7SR1W	Willamette	CL	1M4	60+	11	ENE	X	150	30	83	180
3	5 mi. SW Silverton NE¼SE¼S6T7SR1W	Willamette	SL	1M4	60+	8	ESE	X	150	30	83	180
4	5 mi. SW Silverton NE¼SE¼S6T7SR1W	Willamette	SL	1M3¼	60+	5	E	X	150	64	115	143
5	5 mi. SW Silverton SE¼NW¼S5T7SR1W	Amity	SL	1M23	60+	5	X	X	150	59	114	148
6	5 mi. SW Silverton SE¼SW¼S5T7SR1W	Amity	SL	1M23	60+	11	NNW	N	150	40	81	135
7	5 mi. NW Salem NE¼SW¼S9T7SR2W	Amity	SL	1M23	60	13	NNW	X	150	44	88	137
8	5 mi. NW Silverton NW¼SE¼S18T6SR1W	Willamette	SL	1M45	60+	1	X	X	150	44	101	159
9	8 mi. NW Silverton SW¼NE¼S26T6SR2W	Willamette	SL	1M4	60	5	X	X	150	62	128	163
10	7 mi. NW Salem SW¼NW¼S34T6SR3W	Chehalis	SiL	1M5X	60+	0	X	X	125	105	170	167
11	10 mi. N Salem SW¼SW¼S14T6SR3W	Newberg	VFSL	1M57X	60	0	X	X	125	87	176	187

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
12**	10 mi. N Salem SW¼NE¼S23T6SR3W	Polk	SL	1M3¼B	60+	55	WNW	M	165	64	105	132
13	10 mi. N Salem NE¼SW¼S23T6SR3W	Chehalis	L	1M5X	60+	0	X	X	125	61	129	165
14	7 mi. SW Woodburn SW¼SW¼S19T5SR2W	Willamette	L	1M4	60	17	ENE	X	150	99	163	164
15**	7 mi. SW Woodburn NW¼NW¼S19T5SR2W	Willamette	SL	1M4	60	5	ENE	X	125	50	96	138
16	7 mi. SW Woodburn NW¼S18T5SR2W	Willamette	SL	1M45	60+	0	X	X	150	64	142	166
17	6 mi. NW Woodburn SW¼SW¼S4T5SR2W	Amity	SL	1M23	60+	0	X	X	150	35	86	162
18	West Woodburn SW¼SW¼S2T5SR2W	Willamette	SL	1M4	60+	5	SSE	X	175	39	97	165
19	3 mi. S Woodburn SW¼SW¼S30T5SR1W	Willamette	SL	1M45	60+	2	NE	X	175	58	140	184
20	1 mi. E Mt. Angel SW¼SW¼S11T6SR1W	Olympic	SL	2M3B	48	14	WSW	U	400	79	134	149
21	1 mi. E Mt. Angel NW¼SW¼S11T6SR1W	Olympic	L	2M3B	42	12	WSW	M	300	82	135	147
22	1 mi. E Mt. Angel SE¼NW¼S11T6SR1W	Olympic	CL	2M3B	52	10	NNW	M	300	81	151	165

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
23*'	1 mi. E Mt. Angel NE¼S½S11T6SR1W	Olympic	CL	2M3B	56	20	NNW	U	375	88	132	139
24	1½ mi. SE Mt. Angel NE¼NE¼S14T6SR1W	Olympic	CL	1M3¼B	60+	13	NNE	M	330	87	161	171
25	2 mi. SE Mt. Angel SW¼SW¼S13T6SR1W	Olympic	CL	1M3¼B	60	19	ENE	M	320	91	146	151
26**	5 mi. NE Silverton SE¼S½S35T6SR1E	Olympic	L	3M3B	28	50	ESE	M	900	31	82	173
27**	5 mi. NE Silverton S35T6SR1E	Olympic	L	3M3B	34	60	NW	M	850	32	74	152
28	6 mi. NE Silverton S35T6SR1E	Olympic	CL	3M3B	34	16	SW	M	825	40	86	143
29	6 mi. NE Silverton SE¼SW¼S35T6SR1W	Olympic	CL	1M3¼B	60+	25	WSW	M	925	47	105	157
30**	5 mi. NE Silverton NW¼NE¼S2T6SR1E	Olympic	L	3M3B	28	92	SSE	M	855	47	81	122
31	9 mi. SE Silverton SE¼NW¼S13T7SR1E	Camas	L	3M5XZ	30	0	X	X	740	42	86	138
32**	11 mi. SE Silverton S17T7SR2E	Olympic	L	2vM3B	42	48	ESE	M	1535	67	145	176
33	13 mi. SE Silverton S17T7SR2E	Olympic	SC	3vM3B	30	43	SSW	M	1450	54	108	147

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
34	12 mi. SE Silverton SE¼NW¼S20T7SR2E	Olympic	L	1M3B	60/	34	SW	U	920	45	101	155
35	1¼ mi. SE Silverton NE¼NE¼S28T7SR2E	Olympic	L	2M¾B	36	65	SW	M	1280	74	124	142
36'	1 mi. W Stayton SW¼SW¼S9T9SR1W	Salem	L	3M4Z	28	1	X	X	430	55	102	137
37'	2½ mi. NE Stayton S6T9SR1W	Olympic	L	1M¾B	60	10	NNW	M	730	74	128	147
38'	3 mi. NE Stayton S7T9SR1E	Olympic	SiL	3M4B	22	4	WNW	X	840	51	103	147
39'	3 mi. NE Stayton S7T9SR1E	Olympic	L	2M4B	37	31	SSE	M	800	59	128	165
40	1 mi. N Mehama SW¼NE¼S12T9SR1E	Polk	L	1M3B	60/	20	SW	M	880	55	112	151
41	1 mi. N Mehama SW¼NE¼S12T9SR1E	Polk	L	1M3B	60/	12	SSW	M	900	32	69	143
42	2½ mi. NE Mehama SW¼NW¼S8T9SR2E	Olympic	L	1M3B	60/	15	SSW	M	1620	56	117	157
43	2½ mi. NE Mehama SW¼NW¼S8T9SR2E	Olympic	L	1vM3B	60/	65	SSW	M	1560	62	114	144
44	Adj. E boundary Stayton S10T9SR1W	Clackamas	gL	1gM35Z2	60/	2	X	X	480	86	139	148

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
45'	1 mi. NE Mehama SW¼NW¼S7T9SR2E	Aiken	L	1M3¼B	60+	16	SE	M	1040	45	108	167
46	1 mi. NE Mehama SW¼NW¼S7T9SR2E	Olympic	L	2vM3B	38	17	SSW	M	1150	57	117	156
47'	1 mi. NE Mehama NW¼SW¼S7T9SR2E	Olympic	CL	1M3B	60+	6	SSW	M	1050	43	112	178
48	2½ mi. E Mehama NW¼NW¼S16T9SR2E	Camas	gL	3gM5Z	28	5	X	X	960	57	121	161
49	2½ mi. E Mehama SW¼NW¼S16T9SR2E	Camas	L	2M5Z	42	1	X	X	700	38	94	162
50	3 mi. E Mehama SE¼NW¼S16T9SR2E	Camas	L	3M5Z	32	2	X	X	740	49	94	137
51	4 mi. E Mehama SE¼S½S10T9SR2E	Camas	gL	3gM5Z	28	3	X	X	780	62	114	144
52**	7 mi. SE Mehama NE¼N½S26T9SR2E	Olympic	CL	3M3B	28	15	SSE	M	840	37	80	143
53	6 mi. SE Mehama SW¼S½S23T9SR2E	Olympic	vCL	1vM32B	60+	20	SSW	M	1030	58	133	176
54	5 mi. SE Mehama SE¼S½S16T9SR2E	Olympic	CL	1M3B	60+	49	SSW	M	1000	43	96	152
55	12 mi. SE Mehama NW¼S½S28T9SR3E	Olympic	L	3M3B	30	28	SSW	M	890	40	84	140

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
56	13 mi. SE Mehama NW¼SW¼S27T9SR3E	Olympic	L	3M3B	28	21	SSE	L	950	42	79	127
57	13 mi. SE Mehama SE¼NW¼S27T9SR3E	Olympic	CL	3M3B	24	11	ESE	M	1090	58	95	125
58*	1 mi. SW Sublimity NW¼NW¼S3T9SR1W	Olympic	L	2M3B	37	10	296	X	500	88	144	152
59	3 mi. NE Stayton SE¼NW¼S1T9SR1W	Olympic	L	2M3B	56	25	160	M	550	85	155	166
60	3 mi. NE Stayton S1T9SR1W	Olympic	L	3vM3B	30	19	310	U	565	69	119	141
61	3 mi. SW Silver Falls SE¼SE¼S21T8SR1E	Polk	CL	3M3B	34	4	X	X	1430	46	92	140
62	4 mi. SW Silver Falls NE¼NW¼S27T8SR1E	Olympic	CL	2M3B	56	51	205	M	1460	56	113	151
63**	2 mi. SW Silver Falls NW¼NE¼S27T8SR1E	Olympic	CL	2M32B	52	0	305	U	1790	36	74	136
64	2 mi. S Silver Falls NW¼SE¼S23T8SR1E	Olympic	L	1M3B	60+	21	85	M	1700	62	125	159
65	3 mi. SE Silver Falls S23T8SR1E	Olympic	CL	1M3B	60+	54	310	M	1600	76	129	146
66	2½ mi. SE Silver Falls S24T8SR1E	Olympic	L	2M3B	56	45	20	M	1760	73	145	168

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
67	6 mi. SE Silverton SST7SR1E	Aiken	L	2M3B	40	25	119	M	895	53	96	133
68**	½ mi. S Silver Falls SE¼NW¼S23T8SR1E	Olympic	CL	2M3B	38	23	65	M	1525	59	135	175
69	Silver Falls SW¼NW¼S14T8SR1E	Olympic	L	1M3B	60+	16	45	M	1475	63	151	189
70	3½ mi. NW Forest Grove SE¼NW¼S27T1NR4W	Melbourne	CL	2H3P	48	47	SSE	M	335	54	109	149
71	1¼ mi. NW Forest Grove NE¼SE¼S13T2NR5W	Olympic	L	2M3B	42	16	ESE	U	1460	43	95	150
72**	3 mi. N Forest Grove NE¼NW¼S19T1NR3W	Hillsboro	L	1M5	60+	X	X	X	175	92	166	172
73	6 mi. N Forest Grove NW¼NW¼S1T1NR4W	Hillsboro	SiL	1M3½	60+	5	X	X	175	70	151	179
74	5 mi. NW Mountaindale NW¼SE¼S32T3NR3W	Olympic	L	1M3B	60+	17	SSE	X	600	46	124	188
75'	10 mi. N Mountaindale SE¼NW¼S10T3NR3W	Olympic	L	1M3B	60+	3	X	X	1300	42	87	140
76	9 mi. N Mountaindale SE¼SE¼S16T3NR3W	Carlton	L	2M42S	52	23	SSE	M	700	32	73	150
77	8 mi. N Mountaindale SW¼NW¼S21T3NR3W	Olympic	L	1M3B	60+	55	WSW	M	650	30	75	163

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
78	2 mi. NW Hillsboro NE¼S26T1NR3W	Hillsboro	L	1M55	60+	X	X	X	185	49	102	147
79	9 mi. NE North Plains NE¼S½S33T3NR2W	Melbourne	L	1M34F	60	37	NNW	M	1390	36	88	162
80*1	9 mi. N North Plains NW¼SW¼S29T3NR2W	Cascade	L	3M3S	30	10	SSE	X	1500	40	64	107
81	9 mi. NW North Plains NW¼S½S34T3NR3W	Melbourne	L	2M34F	46	8	SSE	M	1150	47	101	150
82	5 mi. NE West Union SE¼NW¼S9T1NR1W	Cascade	L	3M3F	34	8	SSW	M	800	51	92	130
83	3 mi. NE West Union S7T1NR1W	Cascade	L	3M3S	36	10	ENE	X	300	66	111	136
84	½ mi. SE West Union NE¼SW¼S14T1NR2W	Willamette	L	1M54	60+	X	X	X	200	35	85	160
85	2 mi. E North Plains NE¼NW¼S16T1NR2W	Amity	L	1M23	60+	X	X	X	190	42	80	129
86	4 mi. W Banks SW¼SW¼S10T2NR4W	Aiken	L	2M3B	48	23	ESE	M	250	56	105	140
87	3/4 mi. E Banks SE¼NW¼S30T2NR3W	Melbourne	L	2M3F	52	22	NW	M	300	42	92	149
88	Manning, Oregon NW¼SE¼S14T2NR3W	Aiken	L	2M3B	41	28	NE	M	300	36	87	160

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
89	1 mi. N Manning S½T2NR4W	Melbourne	L	1M3½F	60	7	SSW	X	325	37	85	152
90	7 mi. NW Buxton NW¼NW¼S6T3NR4W	Cascade	L	3M3S	30	43	WSW	M	800	30	55	120
91	7 mi. NW Buxton NW¼NW¼S6T3NR4W	Cascade	L	3M3S	32	3½	NE	M	800	65	112	138
92**	17 mi. N Forest Grove SW¼SE¼S12T3NR4W	Cascade	L	1M3F	60+	7	ESE	X	1800	56	93	125
93	2 mi. S Vernonia SW¼NE¼S18T4NR4W	Melbourne	L	1M3F	60+	5	S43	L	650	43	98	155
94	½ mi. E Vernonia NW¼SE¼S3T4NR4W	Melbourne	L	3M4F	35	9	15	U	820	47	99	147
95	¼ mi. E Vernonia NW¼SE¼S3T4NR4W	Melbourne	L	4M4F	18	136	280	M	810	46	87	132
96	3 mi. N Vernonia NE¼SW¼S27T5NR4W	Melbourne	SiL	2M4F	38	40	215	M	800	65	122	150
97	8 mi. E George SE¼SW¼S16T3SR6E	Olympic	L	2M3B	46	16	182	M	2700	51	104	147
98	2½ mi. SE George NW¼SW¼S28T3SR5E	Olympic	L	2M3½B	54	X	270	U	1200	42	97	157
99	2-3/4 mi. SE George NW¼SW¼S28T3SR5E	Olympic	L	2M3B	56	56	172	M	980	44	96	150

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
100	3 mi. E Garfield NW¼NE¼S31T3SR5E	Cascade	L	2M3¼S	56	X	X	X	1200	36	76	140
101	7 mi. E Cazadero NE¼SW¼S3T4SR5E	Olympic	vL	3vM3B	30	35	183	M	1700	43	71	113
	Numbers from 102 to 200 inclusive, not used.											
201	4 mi. N Lebanon NW¼NW¼S27T11SR2W	Newberg	SL	1M57X	60	1	X	X	260	52	117	164
202	3 mi. S Sodaville SW¼SW¼S18T13SR1W	Aiken	CL	3M3B	30	31	85	M	1260	32	66	135
203'	E boundary Sodaville NE¼SE¼S36T12SR2W	Olympic	L	1M3¼B	60+	34	328	M	420	40	91	152
204'	6 mi. NE Albany SW¼SE¼S15T10SR3W	Melbourne	L	1M3¼F	60	12	210	U	375	62	111	140
205	6 mi. NE Albany SE¼SW¼S15T10SR3W	Melbourne	L	1M3¼F	60	7	215	M	350	28	77	183
206	7 mi. NE Albany SW¼NE¼S10T10SR3W	Olympic	CL	1M3¼B	60	28	22	M	275	40	95	158
207	5 mi. N Albany SE¼NW¼S10T10SR3W	Olympic	L	1M3¼B	60	20	31	M	300	43	97	153
208*'	1 mi. E Lebanon SE¼NW¼S13T12SR2W	Olympic	CL	1M3¼B	60	53	255	U	600	73	78	89

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
209	2 mi. SW Lacomb NE¼NW¼S35T11SR1W	Salkum	SL	2M3Z2	48	2	X	X	435	62	121	153
210	2 mi. SW Lacomb SW¼SW¼S26T11SR1W	Salkum	L	2M3Z2	48	6	245	M	400	31	72	152
211	7 mi. N Lebanon NE¼SE¼S3T11SR2W	Chehalis	SL	1M5X	60	1	X	X	260	66	115	140
212	7 mi. N Lebanon SW¼NE¼S3T11SR2W	Chehalis	SL	1M5X	60	1	X	X	260	33	72	144
213	1½ mi. N Crabtree SE¼NW¼S26T10SR2W	Olympic	CL	2M3U	33+	28	280	M	500	45	101	155
214	9 mi. N Lebanon NW¼NE¼S27T10SR2W	Willamette	SL	1M4	60+	1	X	X	280	36	87	160
215	10 mi. NE Lebanon SE¼NW¼S24T10SR2W	Salkum	L	3M3Z2	37	4	X	X	330	66	117	143
216	3 mi. SE Lebanon NE¼NE¼S30T12SR2W	Willamette	CL	1M3W	60+	1	X	X	380	36	72	132
217	2 mi. N Sweet Home NE¼SE¼S19T13SR1E	Olympic	CL	2M3B	40	10	270	M	840	46	97	147
218	Number not used.											
219	Number not used.											

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
220*'	1 mi. SE Lebanon NE¼SW¼S13T12SR2W	Olympic	CL	1M¾B	60	62	260	M	640	61	77	98
221'	9 mi. NE Brownsville NE¼NE¼S21T13SR1W	Olympic	SiL	1M¾B	60	14	283	U	600	57	105	139
222*'	3 mi. NE Lacomb SE¼SE¼S7T11SR1E	Olympic	CL	1M¾B	60	1	X	X	475	40	76	127
223	4 mi. N Lacomb NE¼NE¼S1T11SR1W	Olympic	CL	2M¾B	42	27	205	U	475	41	98	160
224'	2 mi. NW Lacomb SE¼NW¼S24T11SR1W	Olympic	L	1M¾B	60	3	X	X	600	55	106	143
225*'	3 mi. E Brownsville NW¼NW¼S35T13SR2W	Olympic	CL	3M3B1	22	14	290	U	700	85	87	93
226*'	5 mi. S Sodaville SW¼NE¼S30T13SR1W	Aiken	L	1M¾B	60	18	215	M	1225	45	85	130
227	5 mi. N Sweet Home NE¼SE¼S1T13SR1W	Olympic	CL	1M¾B	60	9	258	M	600	56	109	146
228	3 mi. SE Corvallis NW¼NW¼S17T12SR4W	Willamette	SL	1M¾	60+	2	X	X	224	64	113	140
229	4 mi. E Crawfordsville NE¼SE¼S15T14SR1W	Olympic	CL	1M¾B	60	21	338	M	550	45	103	158
230	12 mi. SE Holley NW¼SE¼S8T15SR2E	Olympic	L	1M¾B	60	21	243	M	1050	40	93	155

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
231	11 mi. SE Holley SE¼NE¼S7T15SR2E	Olympic	L	1M3¼B	60	25	220	L	1175	122	18¼	173
232	2 mi. E Holley SE¼S13T14SR1W	Olympic	L	3vM3B	30	16	166	M	850	87	117	124
233	3 mi. E Holley NW¼SW¼S18T14SR1E	Aiken	L	1M3¼B	60	8	331	M	950	59	113	147
234	4 mi. SE Crawfordsville NE¼SW¼S33T14SR1W	Olympic	SL	3M3B	35	5	300	X	700	50	97	139
235	3 mi. W Sweet Home NE¼SE¼S33T13SR1W	Olympic	CL	3M3B	3¼	26	315	L	1225	52	97	136
236	3 mi. S Crawfordsville SW¼SW¼S29T14SR1W	Aiken	L	1M3¼B	60	33	100	L	725	50	112	160
237[1]	½ mi. S Crawfordsville SE¼NW¼S5T15SR1W	Aiken	L	1M3¼B	60	20	155	M	1025	55	96	130
238	Number not used.											
239	8 mi. S Corvallis NE¼NE¼S8T13SR4W	Willamette	SL	1M3¼	60	3	X	X	250	90	123	128
240	½ mi. E Halsey SE¼SE¼S35T13SR3W	Willamette	L	1M3¼	60+	1	X	X	300	32	69	142
241	½ mi. E Halsey Center S35T13SR3W	Willamette	L	1M3¼	60	1	X	X	300	82	129	141

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
242	9 mi. E Harrisburg SE¼NW¼S12T15SR3W	Olympic	L	1M3B	60	19	63	M	580	34	91	176
243	10 mi. E Harrisburg NW¼SE¼S5T15SR2W	Olympic	CL	3M3B	34	49	190	M	935	62	97	123
244	10 mi. E Harrisburg SE¼NW¼S5T15SR2W	Olympic	L	3M3B	32	62	260	M	1180	60	107	138
245	10 mi. E Harrisburg NW¼NW¼S5T15SR2W	Olympic	L	1M3B	60	44	331	M	1320	85	153	164
246	8 mi. NE Harrisburg NE¼SW¼S36T14SR3W	Olympic	L	1M3B	60	30	47	M	640	44	109	170
247	6 mi. SE Holley SE¼NW¼S9T15SR1W	Olympic	L	1M3B	60+	31	110	M	790	53	103	143
248	2 mi. SW Crawfordsville SW¼SE¼S13T14SR2W	Olympic	L	2M3B	44	22	100	M	660	38	91	159
249	8 mi. W Junction City NE¼NE¼S25T15SR6W	Melbourne	L	1M3F	60	24	162	M	665	38	102	177
250	8 mi. W Junction City SE¼SE¼S25T15SR6W	Melbourne	L	1M3F	60+	32	40	L	620	32	74	152
251'	13½ mi. W Junction City SE¼SE¼S31T15SR6W	Melbourne	L	1M3F	60	25	180	M	650	35	84	158
252*'	7 mi. N Veneta NW¼NW¼S31T16SR5W	Melbourne	L	2M3F	38	14	340	U	880	33	72	144

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
253*'	7 mi. N Veneta SE¼SW¼S30T16SR5W	Melbourne	L	2M3F	48	19	340	U	860	35	67	126
254'	5 mi. NE Eugene SE¼NW¼S10T17SR3W	Olympic	L	3M3B	26	40	200	L	520	51	87	123
255	5 mi. NE Eugene NE¼SW¼S13T17SR3W	Olympic	L	1M3¼B	60/	9	151	L	570	33	89	177
256	10 mi. NW Veneta SE¼NW¼S11T16SR6W	Olympic	L	1M3¼B	60/	22	80	M	710	40	86	143
257'	10 mi. NW Veneta NW¼S11T16SR6W	Melbourne	L	2M3¼F	48	21	167	L	810	57	126	168
258*'	9 mi. NW Veneta SE¼NE¼S15T16SR6W	Melbourne	CL	2M3¼F	46	23	293	M	700	46	67	101
259'	8 mi. NW Veneta NE¼S22T16SR6W	Melbourne	L	1M3¼F	60/	18	151	M	700	37	77	138
260	11 mi. NW Veneta SE¼SE¼S7T16SR6W	Melbourne	L	2M3¼F	42	50	153	M	920	143	153	140
261	8 mi. NW Veneta SE¼SE¼S29T16SR6W	Camas	L	2M5X	36	1	X	X	500	44	89	138
262	8 mi. NW Veneta NE¼NW¼S6T17SR6W	Olympic	L	1M3¼B	60/	11	247	M	600	30	73	158
263	10 mi. NW Veneta NW¼NE¼S25T16SR7W	Melbourne	L	2M3¼F	41	17	165	U	1080	106	160	156

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
264'	5 mi. NE Eugene NW¼S14T17SR3W	Olympic	L	3M3B	23	70	241	M	610	55	93	126
265'	8 mi. NE Eugene NW¼NW¼S17T17SR2W	Olympic	L	1M3¼B	60/	60	140	L	580	37	91	163
266	10 mi. NE Eugene S½NW¼S4T17SR2W	Olympic	L	1M3¼B	60	17	80	M	670	35	83	156
267	15 mi. NE Eugene NE¼SW¼S28T16SR2W	Olympic	L	1M3¼B	60/	22	210	M	710	55	109	147
268	7 mi. SW Veneta NE¼NW¼S12T18SR7W	Aiken	L	1M3¼B	60/	18	180	M	700	47	104	155
269	7 mi. NW Eugene S½SE¼S24T17SR5W	Melbourne	L	2M3¼F	44	33	47	M	520	42	99	160
270'	7 mi. NW Eugene SE¼S24T17SR5W	Melbourne	SL	3M3F	34	1	X	X	580	39	100	163
271	7 mi. NW Eugene NW¼SE¼S24T17SR5W	Melbourne	L	3M3F	34	21	180	U	570	44	81	127
272	7 mi. NW Eugene S½SE¼S24T17SR5W	Melbourne	L	3M3F	35	32	160	M	550	56	106	141
273'	5 mi. SW Eugene NW¼NW¼S5T18SR4W	Melbourne	CL	2M3F	50	23	80	M	680	58	121	158
274	10 mi. NE Eugene NW¼NW¼S10T17SR2W	Olympic	L	1M3¼B	60/	20	41	U	580	31	87	182

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
275'	11 mi. NE Eugene SE¼NE¼S32T17SR2W	Olympic	L	2M3B	45/	45	290	L	690	59	122	158
276'	15 mi. NE Eugene SW¼SW¼S36T16SR2W	Olympic	CL	1M3¼B	60/	27	350	M	750	58	130	171
277	½ mi. N Marcola NW¼SE¼S13T16SR2W	Aiken	L	1M3¼B	60/	12	245	L	680	46	102	154
278	2 mi. NW Marcola SE¼SE¼S10T16SR2W	Aiken	L	1M3¼B	60/	20	80	M	790	37	86	154
279'	2½ mi. NE Marcola NE¼SW¼S5T16SR1W	Aiken	CL	1M3¼B	60/	11	80	M	660	39	93	159
280'	¼ mi. N Marcola SW¼SW¼S30T15SR1W	Willamette	L	1M4	60	1	X	X	790	35	92	173
281	1 mi. E Marcola SE¼SE¼S18T16SR1W	Aiken	L	1M3¼B	60/	39	310	L	640	35	80	150
282	5 mi. NE Marcola NE¼SW¼S11T16SR1W	Camas	L	3M4XZ	24	1	X	X	710	31	78	165
283'	2 mi. NE Marcola NW¼SE¼S8T16SR1W	Olympic	L	1M3¼B	60/	22	335	M	700	45	126	194
284	6 mi. NW Leaburg SE¼SW¼S26T16SR1W	Melbourne	CL	2M3¼F	39	21	290	U	740	40	82	137
285	6 mi. NW Leaburg SW¼SW¼S26T16SR1W	Melbourne	L	1M3¼F	60/	32	310	U	820	38	92	160

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
286'	5 mi. NE Leaburg SE¼SE¼S30T16SR2E	Salem	L	2M3Z	48	6	175	X	760	46	107	162
287'	2 mi. SW Leaburg NW¼NE¼S17T17SR1E	Olympic	L	1vM3B	60/	32	170	M	775	37	94	169
288'	½ mi. E Leaburg NW¼NE¼S10T17SR1E	Olympic	L	1M3B	60	24	150	L	900	41	108	177
289	½ mi. N Leaburg SW¼SE¼S3T16SR1E	Olympic	L	1M34B	60/	37	234	M	950	39	97	165
290	¼ mi. NE Leaburg NW¼S5T17SR2E	Camas	L	3M5XZ	32	2	X	X	860	53	130	180
291	2 mi. SW Leaburg NW¼NE¼S16T17SR1E	Newberg	L	1M57X	60	2	X	X	670	46	112	170
292''	½ mi. S Saginaw NE¼SE¼S16T20SR3W	Olympic	CL	1M34B	60/	11	25	L	700	58	94	124
293	½ mi. W Saginaw SE¼NW¼S16T20SR3W	Olympic	L	3M3B	24	4	62	M	900	41	87	143
294	1-3/4 mi. E Lacomb SW¼SE¼S20T11SR1E	Viola	L	3M21B	60/	5	350	L	500	37	88	158
295'	1½ mi. E Lowell NW¼NW¼S13T19SR1W	Olympic	CL	3M3B	32	45	169	M	1160	39	99	169
296	2 mi. E Vida NW¼NW¼S26T16SR2E	Camas	L	2M5Z	42	2	X	X	900	52	126	177

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
297	15 mi. E Vida SE¼SE¼S14T16SR4E	Olympic	L	2M3B	48	24	150	M	1300	73	127	147
298	1 mi. S Vida NW¼NW¼S33T16SR2E	Olympic	L	1M3/4B	60/	40	30	M	1020	64	138	171
299	6 mi. E Vida NW¼NW¼S2T17SR3E	Camas	L	2M5XZ	36	5	180	X	1100	40	107	179
300	8 mi. SW Philomath NW¼NW¼S3T13SR7W	Olympic	L	1M3/4B	60/	29	265	M	2540	207	173	142
301	6 mi. SW Philomath SE¼SE¼S31T12SR6W	Olympic	L	1M3/4B	60/	2	X	X	560	51	112	158
302	½ mi. S Glenbrook NW¼NW¼S4T15SR6W	Melbourne	L	1M3/4F	60/	14	80	M	630	39	97	165
303'	1½ mi. W Dawson NW¼NW¼S16T14SR6W	Olympic	L	1M3/4B	60/	20	120	M	600	44	118	185
304**	4 mi. W Blodget SE¼NW¼S20T11SR7W	Olympic	L	1M3/4B	60/	42	160	L	690	32	87	178
305'	1½ mi. SW Blodget NW¼NW¼S27T11SR7W	Melbourne	CL	2M3F	50	18	66	M	740	34	89	172
306'	1 mi. NW Conger NW¼SW¼S9T11SR7W	Melbourne	L	2M3F	46	20	210	M	740	32	84	172
307	5 mi. W Hoskins NW¼NE¼S20T10SR7W	Olympic	L	1M3B	60/	27	260	M	840	34	87	168

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
308'	2 mi. W Hoskins SE¼NE¼S26T10SR7W	Melbourne	L	1M3F	60/	21	343	L	1000	57	161	212
309**	6½ mi. N Philomath NW¼NE¼S7T11SR5W	Olympic	CL	2M3AB	42	30	310	M	800	76	122	138
310	4 mi. S Maple Grove SW¼SW¼S6T10SR5W	Olympic	L	1M3B	60/	38	97	L	560	36	90	166
311'	4 mi. N Pedee SW¼SW¼S4T9SR6W	Melbourne	L	1M3F	60/	18	60	L	1150	30	81	176
312'	½ mi. NW Fall City SW¼SE¼S16T8SR6W	Melbourne	L	1M3F	60/	12	160	M	500	59	139	180
313	3 mi. W Fall City NW¼NW¼S19T8SR6W	Melbourne	CL	2M3AF	48	20	350	M	840	39	90	153
314'	5 mi. N Black Rock NW¼SE¼S10T8SR7W	Aiken	CL	2M3B	42	23	165	M	2480	160	125	111
315'	½ mi. W Fall City SW¼SE¼S7T8SR6W	Melbourne	L	3M3F	34	41	47	M	1080	45	88	135
316'	5 mi. SW Fall City SW¼SE¼S25T8SR7W	Aiken	CL	2vM3B	38	7	SE	X	1600	39	86	147
	Numbers 317 to 499 inclusive, not used.											
500'	1 mi. E Gresham SE¼NE¼S11T1SR2E	Powell	SL	1M4CD	60/	20	NW	X	400	52	126	177

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
501	3/4 mi. NE Gresham NE¼NW¼S11T1SR3E	Hillsboro	VFSL	1M5	60+	0	X	X	400	62	123	156
502	1 mi. E Troutdale SW¼NW¼S31T1NR4E	Olympic	vL	3vx3U	28	80	271	M	230	61	86	109
503	1½ mi. E Troutdale NE¼SW¼S31T1NR4E	Hillsboro	L	1M5X	60	19	230	M	355	47	96	143
504	2 mi. S Troutdale SE¼NE¼S1T1SR3E	Powell	L	3M4G	36	5	X	X	265	53	97	134
505	3 mi. SW Troutdale SE¼NW¼S8T1SR3E	Olympic	L	3M43B	34	64	345	M	500	67	121	147
506	3 mi. W Gresham SE¼NW¼S8T1SR3E	Olympic	L	3M43B	36	52	105	M	555	64	99	123
507*'	3 mi. W Gresham SE¼NW¼S8T1SR3E	Olympic	L	3M43B	36	14	50	U	680	69	99	119
508*'	3 mi. W Gresham SE¼NW¼S8T1SR3E	Cascade	L	1M43F	60	13	195	U	680	44	88	137
509	3 mi. W Gresham SW¼NW¼S8T1SR3E	Powell	L	1M42G	60	27	245	M	616	41	101	165
510	4 mi. NW Gresham SW¼NE¼S32T1NR3E	Salem	L	3M4Z	30	2	X	X	220	45	73	112
511*'	2 mi. N Gresham NW¼SE¼S34T1NR3E	Hillsboro	L	1M5	60	2	X	X	370	47	86	129

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
512	7 mi. SE Gresham NE¼SW¼S15T1SR4E	Powell	L	1M43G	60	3	X	X	680	53	128	177
513'	6½ mi. NE Gresham NE¼SE¼S33T1NR4E	Cascade	L	3M4F	30	10	X	M	570	35	60	113
514	7 mi. SE Gresham SE¼SW¼S22T1SR4E	Powell	L	1M43G	60	5	X	X	670	52	114	160
515'	2½ mi. NW Gresham NW¼SE¼S33T1NR3E	Salem	L	3M4Z	32	4	X	X	350	61	98	125
516	2 mi. SW Gresham NW¼NE¼S16T1SR3E	Powell	L	3M3G	36	14	333	M	380	43	94	148
517	2 mi. SW Gresham NW¼NE¼S16T1SR3E	Powell	L	3M3G	35	39	291	M	535	40	97	162
518	2 mi. SW Gresham NW¼S16T1SR3E	Powell	L	3M3G	35	25	322	U	770	46	85	129
519'	2 mi. SW Gresham NE¼NE¼S16T1SR3E	Powell	L	2M42G	38	45	285	M	665	37	87	156
520	2 mi. SW Gresham SE¼NE¼S16T1SR3E	Powell	L	3M3G	36	39	226	M	580	44	89	139
521'	2 mi. SW Gresham SE¼NW¼S21T1SR3E	Powell	L	2M43G	44	36	164	M	630	45	91	140
522	6 mi. W Gresham NW¼SW¼S10T1SR2E	Salem	L	3M4Z	20	2	X	X	310	52	76	106

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
523'	6 mi. W Gresham SW¼NW¼S10T1SR2E	Salem	gL	3g4Z	24	28	159	L	400	56	95	128
524	3 mi. W Troutdale NE¼SE¼S28T1NR3E	Salem	L	2g4Z	59	2	X	X	280	40	84	140
525'	¼ mi. SW Troutdale SW¼NW¼S36T1NR3E	Salem	L	3g4Z	30	3	X	X	280	52	81	113
526'	7 mi. SE Gresham NE¼SW¼S22T1SR4E	Olympic	L	1M43B	60	7	X	X	640	38	94	164
527	15 mi. NE Gresham NW¼SW¼S3T1SR5E	Olympic	L	3M3B	34	3	X	X	1460	54	110	150
528'	4 mi. W Gresham SW¼SW¼S12T1SR2E	Olympic	L	2vM43U	50	55	349	M	350	63	116	145
529	5 mi. SE Gresham NE¼SE¼S26T1SR3E	Powell	L	2M43G	52	40	15	M	620	36	90	166
530	5 mi. SE Gresham NE¼SE¼S26T1SR3E	Powell	L	2M43G	48	45	315	M	580	37	93	167
531	15 mi. NE Gresham SW¼NW¼S34T1NR5E	Olympic	L	1M43B	60	11	295	U	1400	48	116	170
532''	8 mi. NE Gresham NE¼SE¼S33T1NR4E	Cascade	L	1M3F	60+	23	175	M	425	34	72	140
533'	15 mi. NE Gresham NW¼SW¼S34T1NR5E	Olympic	L	2M3B	48	7	250	M	1340	40	99	165

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
534	18 mi. NE Gresham NW¼NW¼S3T1SR5E	Olympic	L	1M43B	60	6	X	X	1400	54	122	167
535'	15 mi. NE Gresham NW¼SE¼S34T1NR5E	Olympic	L	2M3B	48	7	148	M	1740	59	120	156
536'	2 mi. NW Sandy NE¼NE¼S10T2SR4E	Olympic	L	1M43B	60	7	X	X	800	54	113	154
537'	½ mi. E Eagle Creek NE¼SW¼S29T2SR4E	Salem	gL	3g44Z	32	7	SSW	X	400	35	80	150
538	6 mi. SW Eagle Creek NE¼NE¼S4T3SR3E	Olympic	L	2M43B	48	3	X	X	400	36	78	143
539	8 mi. E Gresham SW¼SE¼S2T1SR4E	Powell	L	2M4C	48	36	219	M	700	35	88	166
540'	17 mi. NE Gresham NE¼NW¼S33T1SR5E	Olympic	L	1M3B	60	7	X	X	1100	54	118	161
541	17 mi. NE Gresham SE¼SW¼S20T1SR5E	Olympic	L	2M43B	48	2	X	X	1090	41	98	160
542	3 mi. W Boring NE¼SE¼S33T1SR3E	Powell	L	2M4C	48	2	X	X	640	28	62	148
543	5 mi. SW Boring SW¼NW¼S5T2SR3E	Powell	L	3M4C	24	18	259	M	390	58	104	136
544	6 mi. SW Boring NE¼NE¼S7T2SR3E	Powell	L	2M4C	40	35	216	M	600	47	95	141

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
545	3 mi. SW Gresham SW¼SE¼S20T1SR3E	Powell	L	3M4G	30	16	286	L	510	43	91	144
546	3 mi. SW Gresham SW¼SE¼S20T1SR3E	Olympic	L	3M43B	34	41	266	M	620	43	92	146
547'	3 mi. SW Gresham NE¼SE¼S20T1SR3E	Powell	L	3M3G	30	30	359	U	830	46	89	135
548	3 mi. SW Gresham SE¼SE¼S20T1SR3E	Olympic	L	3M4B	24	45	325	M	670	43	93	147
549	1/5 mi. E Eagle Creek PO NW¼NW¼S4T3SR4E	Carlton	L	3M32S	30	X	X	X	500	42	82	132
550'	3 mi. E Eagle Creek PO NE¼NW¼S4T3SR4E	Olympic	L	2M43B	54	13	251	M	650	32	84	172
551	300 ft. N Dover School NW¼SE¼S6T3SR5E	Olympic	L	1M43B	60	12	3	U	1350	40	93	155
552	7 mi. E Eagle Creek PO NW¼SE¼S1T3SR4E	Olympic	L	1M43B	60	7	X	X	1250	40	98	163
553'	5 mi. S Oregon City NW¼SW¼S22T3SR2E	Olympic	L	1M43B	60	X	X	X	500	41	91	148
554	5 mi. E Oregon City SE¼SW¼S35T2SR2E	Olympic	L	1M43B	60	23	176	M	400	44	93	145
555'	4 mi. ENE Estacada SE¼NE¼S14T3SR4E	Olympic	L	1M43B	60	30	243	M	800	40	96	160

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
556'	¼ mi. ENE Estacada NE¼NE¼S14T3SR4E	Olympic	L	3M43B	34	31	229	M	780	42	85	137
557	¼ mi. ENE Estacada NE¼NE¼S14T3SR4E	Olympic	L	3M4B	24	18	239	M	630	40	79	132
558	¼ mi. ENE Estacada NE¼NE¼S14T3SR4E	Olympic	L	3M4B	35	34	253	M	640	42	90	145
559'	1 mi. E Estacada SE¼NW¼S33T3SR4E	Olympic	L	1M43B	60	33	233	M	560	47	94	140
560'	1 mi. E Estacada SE¼NE¼S33T3SR4E	Olympic	L	1M4B	60	20	181	M	600	46	95	144
561	1½ mi. E Estacada NE¼SE¼S22T3SR4E	Cascade	L	3M4S	28	3	X	X	1010	52	105	147
562	3/4 mi. SE Currinsville NW¼NE¼S17T3SR4E	Salem	GL	2vM4Z	464	X	X	X	510	97	156	158
563	1 mi. E Estacada SE¼SE¼S21T3SR4E	Cascade	L	3M3S	30	3	X	X	840	33	76	152
564	2 mi. E George NE¼SW¼S21T3SR5E	Cascade	L	2M43S	54	20	221	U	1700	43	97	153
565	¼ mi. SW Sandy NE¼SW¼S28T2SR4E	Olympic	L	2M43B	42	14	241	U	740	46	100	151
566	2½ mi. E Currinsville NW¼SE¼S15T3SR4E	Olympic	L	1M43B	60	2	X	X	920	34	85	164

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
567	6 mi. NE Estacada NE¼SW¼S13T3SR4E	Cascade	L	2M43S	40	35	217	M	860	53	107	148
568'	George, Oregon SW¼NW¼S19T3SR5E	Cascade	L	2M34S	45	9	275	U	1220	35	87	164
569	7 mi. NW Boring NW¼SW¼S29T1SR3E	Powell	L	3M3G	34	2	X	X	460	50	93	133
570	6 mi. E Oregon City SE¼SW¼S36T1SR2E	Powell	L	3M4G	23	11	157	M	520	55	104	140
571'	1 mi. NE Gladstone NE¼SW¼S15T2SR2E	Newberg	SL	1L6	60	40	309	L	60	60	109	140
572'	1 mi. NE Gladstone NE¼SW¼S15T2SR2E	Salem	SL	2L63Z	48	70	250	M	150	51	90	127
573'	1½ mi. NW Damascas SW¼NW¼S5T2SR3E	Powell	L	2M43G	50	22	183	M	480	41	93	158
574	2 mi. W Colton SW¼NE¼S7T5SR3E	Olympic	L	3M43B	30	2	X	X	720	57	105	139
575	2 mi. SE Eagle Creek NW¼NE¼S8T3SR4E	Salem	GL	2vM4Z	40	43	NE	X	580	29	63	144
576'	4 mi. W Gresham SW¼NW¼S12T1SR2E	Salem	GL	2vM4Z	38	2	X	X	280	65	101	124
577	5 mi. SW Gresham SW¼NE¼S35T1SR2E	Powell	L	4M2G	19	3	X	X	450	52	94	131

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
578'	3 mi. E Clackamas SE¼NE¼S11T2SR2E	Salem	L	2M4Z	40	35	175	M	200	51	92	130
579'	1 mi. E Clackamas SE¼NE¼S10T2SR2E	Powell	L	1M43G	60	31	178	M	240	40	95	158
580	1 mi. E Clackamas SE¼NE¼S10T2SR2E	Powell	L	3M4G	30	12	180	U	340	40	93	155
581*'	1 mi. W Damascas SE¼NW¼S7T2SR3E	Olympic	L	2M4B	38	12	157	X	400	53	92	127
582	3 mi. S Gresham NE¼SW¼S21T1SR3E	Powell	L	2M42G	50	35	305	U	900	43	97	153
583'	2 mi. E Sandy SW¼NE¼S19T2SR5E	Olympic	L	1M3B	60	2	X	X	1080	36	95	174
584'	2 mi. E Cherryville NE¼SW¼S20T2SR6E	Melbourne	L	2M4F	36	2	X	L	880	30	72	156
585*'	1/10 mi. S Cherryville SE¼NW¼S25T2SR5E	Cascade	L	1M3S	60	8	X	X	1080	30	71	154
586'	9 mi. E Gresham NE¼NE¼S14T1SR4E	Powell	L	3M2G	20	2	X	X	440	37	81	145
587	15 mi. E Gresham NE¼SE¼S6T1SR5E	Olympic	L	1M4B	60	25	278	L	700	40	97	162
588	13 mi. E Gresham NW¼SE¼S17T1SR6E	Salem	GL	2M4Z	40	2	X	X	700	45	94	144

TABLE 1. Chronological list of all plots measured. (Continued)

Plot No.	Location	Soil Series	Surface Texture	Soil Profile	Total Depth	Slope	Aspect	Position	Elevation	Ave. Age	Ave. Height	Site Index
589**	1 mi. W Zigzag SE¼SW¼S33T2SR7E	Toutle	GrS	1C6Z	60	2	X	X	1380	38	62	108
590	½ mi. W Clackamas SW¼SW¼S9T2SR2E	Salem	L	2M3Z	38	2	X	X	200	54	85	116
591*	8 mi. W Molalla SE¼SE¼S12T5SR1W	Hillsboro	L	1M3	60+	3	X	X	280	51	118	167
592	8 mi. SE Gresham SW¼NE¼S28T1SR4E	Powell	L	3M2G	34	4	X	X	600	43	99	157
593	8 mi. SE Gresham NW¼SE¼S34T1SR4E	Olympic	L	1M4B	60	2	X	X	660	45	100	153
594	Kelso, Oregon SW¼SW¼S3T2SR4E	Olympic	L	1M4B	60	3	X	X	760	50	102	146
595	Kelso, Oregon SW¼NE¼S3T2SR4E	Olympic	L	1M4B	60	3	X	X	580	44	95	148

**/ Plots rejected because results appeared questionable. Field checking planned but not done. (A total of 19 plots.)

*/ Plots rejected as not representative after field checking. (A total of 13 plots.)

/ Plots field checked and retained as originally recorded or after making necessary corrections. (A total of 70 plots.)

TABLE 2. Summary of plots on residual hill soils (Olympic, Melbourne, Aiken, Cascade and Polk Series) on north aspects of midslope position with soils over 60" in depth.

Plot No.	Mapping Unit	Average Age Actual	Average Age Reciprocal	Depth Inches	Slope Percent	Elevation Feet	Average Total Precipitation Annual	Average Total Precipitation Warm-Season	Average Height Actual	Average Height Logarithm	Site Index
24	1M3+B	87	.01149	60+	13	330	48	8	161	2.20683	171
25	1M3+B	91	.01099	60	19	320	49	8	146	2.16435	151
37	1M3+B	74	.01351	60	10	730	51	8	128	2.10721	147
64	1M3B	62	.01613	60+	21	1700	73	10	125	2.09691	159
69	1M3B	63	.01587	60+	16	1475	76	10	151	2.17898	189
203	1M3+B	40	.02500	60+	34	420	41	8	91	1.95904	152
206	1M3+B	40	.02500	60	28	275	40	8	95	1.97772	158
207	1M3+B	43	.02326	60	20	300	40	8	97	1.98677	153
229	1M3+B	45	.02222	60	21	550	55	8	103	2.01284	158
242	1M3+B	34	.02941	60	19	580	44	8	91	1.95904	176
245	1M3+B	85	.01176	60	44	1320	48	8	153	2.18469	164
246	1M3+B	44	.02273	60	30	640	42	8	109	2.03743	170
247	1M3+B	53	.01887	60+	31	790	63	8	103	2.01284	143
256	1M3+B	40	.02500	60+	22	710	48	6	86	1.93450	143
266	1M3+B	35	.02857	60	17	670	54	8	83	1.91908	156
276	1M3+B	58	.01724	60+	27	750	73	8	130	2.11394	171
283	1M3+B	45	.02222	60+	22	700	65	8	126	2.10037	194
298	1M3+B	64	.01563	60+	40	1020	81	8	138	2.13988	171
79	1M3+F	36	.02778	60	37	1390	45	8	88	1.94448	162
302	1M3+F	39	.02564	60+	14	630	59	6	97	1.98677	165
233	1M3+B	59	.01695	60	8	950	58	8	113	2.05308	147
278	1M3+B	37	.02703	60+	20	790	62	8	86	1.93450	154
279	1M3+B	39	.02564	60+	11	660	67	8	93	1.96848	159

TABLE 3. Summary of plots on residual hill soils (Olympic, Melbourne, Aiken, Cascade and Polk Series) on north aspects of midslope position with soils under 60" in depth.

Plot No.	Mapping Unit	Average Age Actual	Average Age Reciprocal	Depth Inches	Slope Percent	Elevation Feet	Average Total Precipitation Annual	Average Total Precipitation Warm-Season	Average Height Actual	Average Height Logarithm	Site Index
22	2M3B	81	.01235	52	10	300	47	8	151	2.17898	165
66	2M3B	73	.01370	56	45	1760	75	10	145	2.16137	168
248	2M3B	38	.02632	44	22	660	50	8	91	1.95904	159
528	2M43U	63	.01587	50	55	350	44	10	116	2.06446	145
57	3M3B	58	.01724	24	11	1090	88	14	95	1.97772	125
293	3M3B	41	.02439	24	4	900	45	10	87	1.93952	143
505	3M43B	67	.01493	34	64	500	44	11	121	2.08279	147
506	3M43B	64	.01563	36	52	555	45	12	99	1.99564	123
548	3M4B	43	.02326	24	45	670	47	12	93	1.96848	147
87	2M3F	42	.02381	52	22	300	46	8	92	1.96379	149
269	2M34F	42	.02381	44	33	520	41	8	99	1.99564	160
273	2M3F	58	.01724	50	23	680	40	8	121	2.08279	158
305	2M3F	34	.02942	50	18	740	66	8	89	1.94939	172
313	2M34F	39	.02564	48	20	840	79	10	90	1.95424	153
315	3M3F	45	.02222	34	41	1080	76	10	88	1.94448	135
67	2M3B	53	.01887	40	25	895	57	8	96	1.98227	133
86	2M3B	56	.01786	48	23	250	49	8	105	2.02119	140
88	2M3B	36	.02778	41	28	300	47	8	87	1.93952	160
202	3M3B	32	.03125	30	31	1260	43	8	66	1.81954	135
83	3M3S	66	.01515	36	10	300	37	8	111	2.04532	136
91	3M3S	65	.01538	32	34	800	58	10	112	2.04922	138

TABLE 4. Summary of plots on residual hill soils (Olympic, Melbourne, Aiken, Cascade and Folk Series) on level or nearly level aspects where position is definitely unimportant.

Plot No.	Mapping Unit	Average Age		Depth	Slope	Elevation	Average Total Precipitation		Average Height		Site
		Actual	Reciprocal	Inches	Percent	Feet	Annual	Warm-Season	Actual	Logarithm	Index
75	1M3B	42	.02381	60+	3	1300	60	10	87	1.93952	140
224	1M3+B	55	.01818	60	3	600	51	8	106	2.02531	143
301	1M3+B	51	.01961	60+	2	560	70	6	112	2.04922	158
526	1M3+B	38	.02632	60	7	640	65	16	94	1.97313	164
534	1M3+B	54	.01852	60	6	1400	74	16	122	2.08636	167
536	1M3+B	54	.01852	60	7	800	80	16	113	2.05308	154
540	1M3B	54	.01852	60	7	1100	88	18	118	2.07188	161
552	1M43B	40	.02500	60	7	1250	72	16	98	1.99123	163
553	1M43B	41	.02439	60	0	500	46	12	91	1.95904	148
566	1M43B	34	.02941	60	2	920	62	16	85	1.92942	164
583	1M3B	36	.02778	60	2	1080	82	18	95	1.97772	174
593	1M4B	45	.02222	60	2	660	70	16	100	2.00000	153
594	1M4B	50	.02000	60	3	760	69	16	102	2.00860	146
595	1M4B	44	.02273	60	3	580	70	16	95	1.97772	148
538	2M43B	36	.02778	48	3	400	51	12	78	1.89209	143
541	2M43B	41	.02439	48	2	1090	80	18	98	1.99123	160
38	3M3B	51	.01961	22	4	840	62	8	103	2.01284	147
234	3M3B	50	.02000	35	5	700	59	8	97	1.98677	139
527	3M3B	54	.01852	34	3	1460	76	16	110	2.04139	150
574	3M43B	57	.01754	30	2	720	48	12	105	2.02119	139
584	2M4F	30	.03333	36	2	880	92	19	72	1.85733	156
270	3M3F	39	.02564	34	1	580	41	8	100	2.00000	163
61	3M3B	46	.02174	34	4	1430	70	8	92	1.96379	140
100	2M34S	36	.02778	56	0	1200	70	14	76	1.88081	140
513	3M4F	35	.02857	30	10	570	54	14	60	1.77815	113
561	3M4S	52	.01923	28	3	1010	60	14	105	2.02119	147
563	3M3S	33	.03030	30	3	840	57	14	76	1.88081	152

TABLE 5. Summary of plots on residual hill soils (Olympic, Melbourne, Aiken, Cascade and Polk Series) on south aspects of midslope position with soils over 60" in depth.

Plot No.	Mapping Unit	Average Age Actual	Average Age Reciprocal	Depth Inches	Slope Percent	Elevation Feet	Average Total Precipitation Annual	Average Total Precipitation Warm-Season	Average Height Actual	Average Height Logarithm	Site Index
29	1M3½B	47	.02128	60+	25	925	60	10	105	2.02119	157
42	1M3B	56	.01786	60+	15	1620	72	10	117	2.06819	157
47	1M3B	43	.02326	60+	6	1050	70	10	112	2.04922	178
54	1M3B	43	.02326	60+	49	1000	74	12	96	1.98227	152
65	1M3B	76	.01316	60+	54	1600	72	10	129	2.11059	146
74	1M3B	46	.02174	60+	17	600	51	8	124	2.09342	188
77	1M3B	30	.03333	60+	55	650	57	10	75	1.87506	163
227	1M3½B	56	.01786	60	9	600	52	8	109	2.03743	146
230	1M3½B	40	.02500	60	21	1050	76	8	93	1.96848	155
262	1M3½B	30	.03333	60+	11	600	54	8	73	1.86332	158
267	1M3½B	55	.01818	60+	22	710	56	8	109	2.03743	147
289	1M3½B	39	.02564	60+	37	950	83	8	97	1.98677	165
300	1M3½B	207	.00483	60+	29	2540	93	6	173	2.23805	142
303	1M3½B	44	.02273	60+	20	600	64	6	118	2.07188	185
307	1M3B	34	.02941	60+	27	840	79	10	87	1.93952	168
554	1M43B	44	.02273	60	23	400	49	12	93	1.96848	145
555	1M43B	40	.02500	60	30	800	66	16	96	1.98227	160
559	1M43B	47	.02128	60	33	560	57	14	94	1.97313	140
560	1M4B	46	.02174	60	20	600	57	14	95	1.97772	144
43	1vM3B	62	.01613	60+	65	1560	72	10	114	2.05690	144
53	1vM32B	58	.01724	60+	20	1030	72	10	133	2.12385	176
287	1vM3B	37	.02703	60+	32	775	62	8	94	1.97313	169
89	1M3½F	37	.02703	60	7	325	51	10	85	1.92942	152
249	1M3½F	38	.02632	60+	24	665	48	6	102	2.00860	177
251	1M3½F	35	.02857	60	25	650	62	6	84	1.92428	158

TABLE 5. (Continued)

Plot No.	Mapping Unit	Average Age Actual	Average Age Reciprocal	Depth Inches	Slope Percent	Elevation Feet	Average Total Precipitation Annual	Average Total Precipitation Warm-Season	Average Height Actual	Average Height Logarithm	Site Index
259	1N34F	37	.02703	60+	18	700	49	6	77	1.88649	138
205	1N34F	28	.03571	60	7	350	41	8	77	1.88649	183
312	1N3F	59	.01695	60+	12	500	67	10	139	2.14301	180
40	1N3B	55	.01818	60+	20	880	69	10	112	2.04922	151
41	1N3B	32	.03125	60+	12	900	69	10	69	1.83885	143
45	1N34B	45	.02222	60+	16	1040	70	10	108	2.03342	167
268	1N34B	47	.02128	60+	18	700	55	8	104	2.01703	155

TABLE 6. Summary of plots on residual hill soils (Olympic, Melbourne, Aiken, Cascade and Polk Series) on south aspects of midslope position with soils under 60" in depth.

Plot No.	Mapping Unit	Average Age		Depth	Slope	Elevation	Average Total Precipitation		Average Height		Site
		Actual	Reciprocal	Inches	Percent	Feet	Annual	Warm-Season	Actual	Logarithm	Index
21	2M3B	82	.01220	42	12	300	47	8	135	2.13033	147
35	2M¾B	74	.01351	36	65	1280	76	10	142	2.15229	142
39	2M4B	59	.01695	37	31	800	62	8	128	2.10721	165
58	2M3B	88	.01136	37	10	500	57	8	144	2.15836	152
59	2M3B	85	.01176	56	25	550	60	8	155	2.19033	166
62	2M3B	56	.01786	56	51	1460	70	8	113	2.05308	151
99	2M3B	44	.02273	56	56	980	75	14	96	1.98227	150
213	2M3U	45	.02222	33/	28	500	45	8	101	2.00432	155
217	2M3B	46	.02174	40	10	840	54	8	97	1.98677	147
297	2M3B	73	.01370	48	24	1300	71	12	127	2.10380	147
533	2M3B	40	.02500	48	7	1340	71	16	99	1.99564	165
535	2M3B	59	.01695	48	7	1740	73	16	120	2.07918	156
550	2M43B	32	.03125	54	13	650	64	16	84	1.92428	172
97	2M3B	51	.01961	46	16	2700	106	16	104	2.01703	147
46	2vM3B	57	.01754	38	17	1150	70	10	117	2.06819	156
28	3M3B	40	.02500	34	16	825	60	10	86	1.93450	143
55	3M3B	40	.02500	30	28	890	86	14	84	1.92428	140
243	3M3B	62	.01613	34	49	935	48	8	97	1.98677	123
244	3M3B	60	.01667	32	62	1180	46	8	107	2.02938	138
295	3M3B	39	.02564	32	45	1160	47	8	99	1.99564	169
546	3M43B	43	.02326	34	41	620	47	12	92	1.96379	146
556	3M43B	42	.02381	34	31	780	67	16	85	1.92942	137
557	3M4B	40	.02500	24	18	630	66	16	79	1.89763	132
558	3M4B	42	.02381	35	34	640	66	16	90	1.95424	145
33	3vM3B	54	.01852	30	43	1450	71	10	108	2.03342	147

TABLE 6. (Continued)

Plot No.	Mapping Unit	Average Age Actual	Average Age Reciprocal	Depth Inches	Slope Percent	Elevation Feet	Average Total Precipitation Annual	Average Total Precipitation Warm-Season	Average Height Actual	Average Height Logarithm	Site Index
101	3vM3B	43	.02326	30	35	1700	75	14	71	1.85126	113
232	3vM3B	87	.01149	30	16	850	58	8	117	2.06819	124
264	3vM3B	55	.01818	23	70	610	46	8	93	1.96848	126
502	3vM3U	61	.01639	28	80	230	49	12	86	1.93450	109
81	2M34F	47	.02128	46	8	1150	50	8	101	2.00432	150
96	2M4F	65	.01538	38	40	800	49	12	122	2.08636	150
260	2M34F	143	.00699	42	50	920	59	6	153	2.18469	140
306	2M3F	32	.03125	46	20	740	65	10	84	1.92428	172
272	3M3F	56	.01786	35	32	550	41	8	106	2.02531	141
95	4M4F	46	.02174	18	136	810	54	12	87	1.93952	132
314	2M3B	160	.00625	42	23	2480	95	12	125	2.09691	111
316	2vM3B	39	.02564	38	7	1600	79	10	86	1.93450	147
567	2M43S	53	.01887	40	35	860	67	16	107	2.02938	148
82	3M3F	51	.01961	34	8	800	39	8	92	1.96379	130
90	3M3S	30	.03333	30	43	800	58	10	55	1.74036	120

TABLE 7. Summary of regression analyses.

Analysis number and description	No. of Plots	Item[1]	Reciprocal of age X_1	Soil Depth X_2	Slope Percent X_3	Elevation Feet X_4	Total Precipitation Annual X_5	Total Precipitation Warm-Season X_6
Residual hill soils including Olympic, Melbourne, Aiken, Cascade and Polk.								
1. N aspects, M positions, soils over 60". (From table 2.)	23	1	- 13.539,482	not used	≠ .000,514	- .000,014	≠ .000,778	≠ .011,772[2]
		2	9.093,241**	not used	.580,790	.500,000	.979,848	1.019,838[2]
2. N aspects, M positions, soils under 60". (From table 3.)	21	1	- 11.494,441	≠ .003,452	- .000,320	≠ .000,019	- .000,725	≠ .004,217
		2	5.835,950**	2.407,252*	.501,567	.678,571	.713,582	.403,579
3. N and X aspects, M and X positions, all soil depths. (From tables 2, 3 and 4.)	71	1	- 13.320,182	≠ .001,986	- .000,137	≠ .000,008	≠ .000,286	≠ .000,219
		2	16.064,360**	3.098,284**	.318,605	.533,333	.639,821	.110,998
4. S aspects, M positions, soils over 60". (From table 5.)	32	1	- 13.213,100	not used	- .000,330	- .000,022	≠ .000,703	- .004,927[3]
		2	9.142,311**	not used	.626,804	.728,960	.756,052	1.627,152[3]
5. S aspects, M positions, soils under 60". (From table 6.)	40	1	- 12.037,842	≠ .003,630	- .000,146	- .000,027[4]	≠ .000,545	- .003,041
		2	10.234,615**	4.442,720**	.514,227	1.386,963[4]	.665,446	1.107,034[3]
6. S and X aspects, M and X positions, all soil depths. (From tables 4, 5 and 6.)	99	1	- 14.112,199	≠ .002,165	- .000,362	- .000,025	≠ .000,821	- .001,455[3]
		2	21.782,286**	4.147,509**	1.925,531*	2.272,727**	2.073,232**	1.173,387[3]

TABLE 7. Summary of regression analyses. (Continued)

Analysis number and description	No. of Plots	Item[1/]	Reciprocal of age X_1	Soil Depth X_2	Slope Percent X_3	Elevation Feet X_4	Total Precipitation Annual X_5	Warm-Season X_6
			Powell Soil Series					
7. All aspects, all positions, all soil depths.		1	- 12.120,703	+ .002,160	+ .000,087	- .000,029	not used	not used
(From table 15.)	28	2	8.369,790**	4.770,329**	.211,124	.773,643	not used	not used

** Highly significant above the 1% level.

* Significant above the 5% level.

1/ Item 1 = Regression coefficients.
Item 2 = Value of t.

2/ Significant at about the 35% level.

3/ Significant at about the 75% level.

4/ Significant at about the 85% level.

TABLE 8. Site index on north and level aspects as influenced by total effective depth of soil.*

Soil Depth -inches-	Logarithm of average tree height	Estimated site index
6	2.074,744 ± .057,423	118.8 ± 15.8
10	2.082,744 ± .052,808	121.0 ± 14.8
14	2.090,744 ± .048,240	123.2 ± 13.8
18	2.098,744 ± .043,827	125.5 ± 12.7
20	2.102,744 ± .041,611	126.7 ± 12.2
30	2.122,744 ± .031,401	132.7 ± 9.6
40	2.142,744 ± .023,329	138.9 ± 7.5
50	2.162,744 ± .020,253	145.4 ± 6.8
60	2.182,744 ± .024,162	152.3 ± 8.5
70	2.202,744 ± .032,572	159.5 ± 12.0
80	2.222,744 ± .043,009	167.0 ± 16.6
90	2.242,744 ± .054,244	174.9 ± 21.9

* Calculated from equation #1. Average tree age held at 100 years therefore $X_1 = 0.01$. Fiducial limits are at the 5% level. Field data includes soil depths between 22 and 60 inches only. Other values are based on the equation.

TABLE 9. Site index on south and level aspects as influenced by total effective depth of soil.*

Soil Depth -inches-	Logarithm of average tree height	Estimated site index
6	2.069,483 ± .049,372	117.3 ± 13.4
10	2.078,239 ± .042,687	119.7 ± 11.8
14	2.086,995 ± .038,867	122.3 ± 11.0
18	2.095,751 ± .035,136	124.7 ± 10.1
20	2.100,129 ± .033,291	125.9 ± 9.7
30	2.122,019 ± .024,805	132.4 ± 7.6
40	2.143,909 ± .018,310	139.3 ± 5.9
50	2.165,799 ± .016,498	146.5 ± 5.6
60	2.187,689 ± .020,543	154.1 ± 7.3
70	2.209,579 ± .028,156	162.1 ± 10.5
80	2.231,469 ± .037,102	170.4 ± 14.6
90	2.253,359 ± .046,661	179.2 ± 19.3

* Calculated from equation #2. Average tree age held at 100 years ($X_1 = 0.01$). Other variables held at the mean (i.e. soil depth, $X_2 = 48$ inches; percent slope, $X_3 = 22$; elevation, $X_4 = 927$ feet; total annual precipitation, $X_5 = 64$ inches). Fiducial limits are at the 5% level. Field data includes soil depths between 18 and 60 inches only. Other values are based on the equation.

TABLE 10. Site index on south and level aspects as influenced by slope.*

Slope Percent	Logarithm of average tree height	Estimated site index
5	2.167,118 ± .017,540	146.9 ± 6.0
10	2.165,398 ± .016,968	146.4 ± 5.7
15	2.163,678 ± .016,498	145.8 ± 5.6
20	2.161,958 ± .016,377	145.2 ± 5.5
25	2.160,238 ± .016,377	144.6 ± 5.5
30	2.158,518 ± .016,617	144.1 ± 5.5
40	2.155,070 ± .017,652	142.9 ± 5.9
50	2.151,638 ± .019,358	141.8 ± 6.3
60	2.148,198 ± .021,574	140.7 ± 7.0
70	2.144,758 ± .024,162	139.6 ± 7.8
80	2.141,318 ± .027,085	138.5 ± 8.7
90	2.137,878 ± .030,120	137.4 ± 9.5
100	2.134,438 ± .033,351	136.3 ± 10.5
110	2.130,998 ± .036,673	135.2 ± 11.4
120	2.127,558 ± .040,066	134.2 ± 12.4
130	2.124,118 ± .043,511	133.1 ± 13.4

* Calculated from equation #2. Average tree age held at 100 years and other variables except slope held at the mean. Fiducial limits are at the 5 percent level.

TABLE 11. Site index on south and level aspects as influenced by slope and different soil depths.*

Slope Percent	Site index at total effective soil depth of - 6"	24"	36"	48"	60"	84"
10	118.5	129.7	137.9	146.5	155.6	175.6
20	117.6	128.7	136.8	145.3	154.7	174.2
30	116.6	127.7	135.7	144.2	153.1	172.8
40	115.7	126.7	134.6	143.0	151.9	171.5
50	114.8	125.7	133.6	141.9	150.8	170.1
60	113.9	124.7	132.5	140.8	149.6	168.8
70	113.0	123.7	131.5	139.7	148.4	167.4
80	112.1	122.7	130.4	138.5	147.2	166.1
90	111.2	121.8	129.4	137.5	146.0	164.8
100	110.3	120.8	128.7	136.4	144.9	163.5
110	109.5	119.9	127.3	135.3	143.7	162.2
120	108.6	118.9	126.4	134.2	142.6	160.9

* Calculated from equation #2. Average tree age held at 100 years and other variables except slope held at the mean. Relationships for soils 6 inches and 84 inches in depth were not represented by actual field data. Results shown were obtained from the equation.

TABLE 12. Site index on south and level aspects as influenced by elevation.*

Elevation -feet-	Logarithm of average tree height	Estimated site index
300	2.175,548 ± .018,311	149.8 ± 6.4
600	2.168,648 ± .016,011	147.4 ± 5.5
900	2.161,747 ± .016,134	145.1 ± 5.4
1200	2.154,848 ± .018,736	142.9 ± 6.2
1500	2.147,948 ± .022,817	140.6 ± 7.4
1800	2.141,048 ± .027,875	138.4 ± 7.9
2100	2.134,148 ± .033,410	136.2 ± 10.5
2400	2.127,247 ± .039,220	134.1 ± 12.1
2700	2.120,348 ± .045,245	131.9 ± 13.8

* Calculated from equation #2. Average tree age held at 100 years and other variables except elevation held at the mean. Fiducial limits are at the 5 percent level.

TABLE 13. Site index on south and level aspects as influenced by total annual precipitation.*

Total annual precipitation -inches-	Logarithm of average tree height	Estimated site index
30	2.140,836 ± .030,958	138.3 ± 9.9
40	2.146,876 ± .024,565	140.3 ± 8.0
50	2.152,916 ± .019,459	142.2 ± 6.4
60	2.158,956 ± .016,498	144.2 ± 5.5
70	2.164,996 ± .017,199	146.2 ± 5.8
80	2.171,036 ± .020,924	148.3 ± 7.2
90	2.177,076 ± .026,644	150.3 ± 9.2
100	2.183,116 ± .033,172	152.4 ± 11.6
110	2.189,156 ± .040,262	154.5 ± 14.4

* Calculated from equation #2. Average tree age held at 100 years and all other variables except precipitation held at the mean. Fiducial limits are at the 5 percent level.

TABLE 14. Summary of plots on residual hill soils (Olympic, Melbourne, Aiken, Cascade and Polk Series) of upper and lower slope positions.

Plot No.	Mapping Unit	Average Age Actual	Depth Inches	Slope Percent	Elevation Feet	Average Total Precipitation Annual	Warm-Season	Average Height Actual	Site Index
				North Aspects Upperslope Positions					
274	1M3L4B	31	60+	20	580	55	8	87	182
551	1M43B	40	60	12	1350	78	16	93	155
71	2M3B	43	42	16	1460	55	10	95	150
94	3M4F	47	35	9	820	53	12	99	147
				North Aspects Lowerslope Positions					
310	1M3B	36	60+	38	560	62	8	90	166
235	3M3B	52	34	26	1225	50	8	97	136
93	1M3F	43	60+	5	650	52	12	98	155
250	1M34F	32	60+	32	620	48	6	74	152
308	1M3F	57	60+	21	1000	69	10	161	212
311	1M3F	30	60+	18	1150	67	10	81	176
281	1M34B	35	60+	39	640	63	8	80	150
				South Aspects Upperslope Positions					
34	1M3B	45	60+	34	920	73	10	101	155
221	1M34B	57	60	14	600	48	8	105	139
531	1M34B	48	60	11	1400	69	16	116	170
20	2M3B	79	48	14	400	47	8	134	149
98	2M34B	42	54	0	1200	75	14	97	157
223	2M34B	41	42	27	475	55	8	98	160
565	2M34B	46	42	14	740	63	16	100	151
60	3vM3B	69	30	19	565	61	8	119	141

TABLE 14. (Continued)

Plot No.	Mapping Unit	Average Age Actual	Depth Inches	Slope Percent	Elevation Feet	Average Total Precipitation Annual	Warm-Season	Average Height Actual	Site Index
				South Aspects Upperslope Positions					
285	1M34F	38	60/	32	820	73	8	92	160
204	1M34F	62	60	12	375	41	8	111	140
263	2M34F	106	41	17	1080	57	8	160	156
284	2M34F	40	39	21	740	73	8	82	137
271	2M3F	44	34	21	570	43	8	81	127
564	2M34S	43	54	20	1700	77	14	97	153
568	2M34S	35	45	9	1220	70	15	87	164
				South Aspects Lowerslope Positions					
231	1M34B	122	60	25	1175	74	8	184	173
255	1M34B	33	60/	9	570	48	8	89	177
265	1M34B	37	60/	60	580	51	8	91	163
288	1M3B	41	60	24	900	65	8	108	177
587	1M4B	40	60	25	700	67	16	97	162
275	2M3B	59	45/	45	690	56	8	122	158
56	3M3B	42	28	21	950	87	14	79	127
254	3M3B	51	26	40	520	46	8	87	123
257	2M34F	57	48	21	810	49	6	126	168
236	1M34B	50	60	33	725	45	8	112	160
277	1M34B	46	60/	12	680	64	8	102	154

TABLE 15. Summary of plots on the Powell Series.

Plot No.	Mapping Unit	Average Age Actual	Average Age Reciprocal	Depth Inches	Slope Percent	Aspect[1]	Position[2]	Elevation Feet	Average Total Precipitation Annual	Average Total Precipitation Warm-Season	Average Height Actual	Average Height Logarithm	Site Index
500	1M42G	52	.019231	60/	20	N	X	400	43	10	126	2.10037	177
509	1M42G	41	.024390	60	27	S	M	616	45	11	101	2.00432	165
514	1M43G	52	.019231	60	5	X	X	670	65	16	114	2.05690	160
512	1M43G	53	.018868	60	3	X	X	680	63	15	128	2.10721	177
579	1M43G	40	.025000	60	31	S	M	240	47	12	95	1.97772	158
519	2M42G	37	.027027	38	45	S	M	665	47	12	87	1.93952	156
582	2M42G	43	.023256	50	35	S	U	900	48	12	97	1.98677	153
521	2M43G	45	.022222	44	36	S	M	630	47	12	91	1.95904	140
529	2M43G	36	.027778	52	15	N	M	620	47	12	90	1.95424	166
530	2M43G	37	.027027	48	45	N	M	580	53	13	93	1.96848	167
573	2M43G	41	.024390	50	22	S	M	480	49	12	93	1.96848	158
539	2M4G	35	.028571	48	36	S	M	700	60	16	88	1.94448	166
544	2M4G	47	.021277	40	35	S	M	600	50	12	95	1.97772	141
542	2M4G	28	.035714	48	2	X	X	640	51	12	62	1.79239	148
586	3M2G	37	.027027	20	2	X	X	440	67	16	81	1.90849	145
547	3M3G	46	.021739	30	30	N	U	830	47	12	89	1.94939	135
520	3M3G	44	.022727	36	39	S	M	580	47	12	89	1.94939	139
516	3M3G	43	.023256	36	14	N	M	380	47	12	94	1.97313	148
518	3M3G	46	.021739	35	25	N	U	770	47	12	85	1.92942	129
569	3M3G	50	.020000	34	2	X	X	460	48	12	93	1.96848	133
517	3M3G	40	.025000	35	39	S	M	535	47	12	97	1.98677	162
543	3M4G	58	.017241	24	18	S	M	390	49	12	104	2.01703	136
545	3M4G	43	.023256	30	16	S	L	510	47	12	91	1.95904	144
580	3M4G	40	.025000	30	12	S	U	340	47	12	93	1.96848	155
570	3M4G	55	.018182	23	11	S	M	520	47	12	104	2.01703	140

TABLE 15. Summary of plots on the Powell Series. (Continued)

Plot No.	Mapping Unit	Average Age Actual	Average Age Reciprocal	Depth Inches	Slope Percent	Aspect[1]	Position[2]	Elevation Feet	Average Total Precipitation Annual	Average Total Precipitation Warm-Season	Average Height Actual	Average Height Logarithm	Site Index
504	3M4G	53	.018868	36	5	X	X	265	49	12	97	1.98677	134
592	3M42G	43	.023256	34	4	X	X	600	64	15	99	1.99564	157
577	4M2G	52	.019231	19	3	X	X	450	46	12	94	1.97313	131

1/ Aspect: X -- level or nearly level plots where aspect is unimportant.
N -- north aspects.
S -- south aspects.

2/ Position: X -- level or nearly level plots where position is unimportant.
L -- lowerslope positions.
M -- midslope positions.
U -- upperslope positions.

TABLE 16. Site index for douglas fir on Powell soils as influenced by total effective depth of soil.*

Soil Depth -inches-	Logarithm of average tree height	Estimated site index
6	2.064,263 ± .045,220	116.0 (128.7 - 104.4)
10	2.072,723 ± .043,490	118.2 (130.7 - 107.0)
14	2.081,183 ± .041,996	120.5 (132.8 - 109.4)
18	2.089,643 ± .040,708	122.9 (135.0 - 111.9)
20	2.093,873 ± .040,182	124.1 (136.2 - 113.2)
30	2.115,023 ± .038,669	130.3 (142.7 - 119.2)
40	2.136,173 ± .039,162	137.0 (149.7 - 125.0)
50	2.157,323 ± .041,588	143.7 (158.1 - 130.5)
60	2.178,473 ± .045,641	150.8 (167.5 - 135.8)
70	2.198,623 ± .050,935	158.0 (177.7 - 140.5)
80	2.220,773 ± .057,088	166.3 (189.6 - 145.8)
90	2.241,923 ± .063,951	174.6 (202.3 - 150.7)

* Calculated from equation #3. Average tree age held at 100 years and soil depths varied as shown. Fiducial limits are at the 5 percent level. Field data includes soil depths from 19 inches to 60 inches and over. Depths greater than 60 inches were not determined and have been given a numerical value of 60 inches.

TABLE 17. Summary of plots on miscellaneous soilsshowing average site index and coefficient of variation for different depth classes.

Plot No.	Mapping Unit	Average Age Actual	Depth Inches	Slope Percent	Aspect	Position	Elevation Feet	Average Total Precipitation Annual	Warm-Season	Average Height Actual	Site Index
Willamette (wet phase) -- depth group "1"											
1	1M34	60	60	4	S	X	150	46	8	110	140
228	1M34	64	60+	2	X	X	224	36	6	113	140
216	1M34	36	60+	1	X	X	380	35	8	72	132
239	1M34	90	60	3	X	X	250	35	6	123	128
4	1M34	64	60+	5	S	X	150	44	8	115	143
240	1M34	32	60+	1	X	X	300	33	8	69	142
241	1M34	82	60	1	X	X	300	33	8	129	141
										Average = 138	± 4
Willamette -- depth group "1"											
2	1M4	30	60+	11	N	X	150	43	8	83	180
3	1M4	30	60+	8	S	X	150	44	8	83	180
8	1M4	44	60+	1	X	X	150	41	8	101	159
9	1M4	62	60	5	X	X	150	40	8	128	163
14	1M4	99	60	17	N	X	150	34	8	163	164
16	1M4	64	60+	0	X	X	150	33	8	142	166
18	1M4	39	60+	5	S	X	175	36	8	97	165
19	1M4	58	60+	2	N	X	175	41	8	140	184
84	1M54	35	60+	0	X	X	200	37	8	85	160
214	1M4	36	60+	1	X	X	280	44	8	87	160
280	1M4	35	60	1	X	X	790	66	8	92	173
										Average = 169	± 5

TABLE 17. (Continued)

Plot No.	Mapping Unit	Average Age Actual	Depth Inches	Slope Percent	Aspect	Position	Elevation Feet	Average Total Precipitation Annual	Precipitation Warm-Season	Average Height Actual	Site Index
Amity -- depth group "1"											
85	1M23	42	60+	0	X	X	190	39	8	80	129
6	1M23	40	60	11	N	M	150	46	8	81	135
7	1M23	44	60	13	N	X	150	42	8	88	137
5	1M23	59	60+	5	X	X	150	44	8	114	148
17	1M23	35	60+	0	X	X	150	34	8	86	162
										Average =	142 ± 9
Hillsboro											
503	1M5	47	60	19	S	M	355	50	13	96	143
78	1M5	49	60+	0	X	X	185	41	8	102	147
501	1M5	62	60+	0	X	X	400	48	12	123	156
										Average =	149 ± 4
Hillsboro (wet phase)											
591	1M34	51	60+	3	X	X	280	42	10	118	167
73	1M34	70	60+	5	X	X	175	47	8	151	179
										Average =	173

TABLE 17. (Continued)

Plot No.	Mapping Unit	Average Age Actual	Depth Inches	Slope Percent	Aspect	Position	Elevation Feet	Average Total Precipitation Annual	Warm-Season	Average Height Actual	Site Index
Salem -- depth group "2"											
572	2L63Z	51	48	70	S	M	150	47	12	90	127
590	2M43Z	54	38	2	X	X	200	47	10	85	116
578	2M4Z	51	40	35	S	M	200	55	14	92	130
588	2M4Z	45	40	2	X	X	700	105	18	94	144
524	2M4Z	40	59	2	X	X	280	44	12	84	140
576	2vM4Z	65	38	2	X	X	280	43	10	101	124
575	2vM4Z	29	40	43	N	X	580	57	15	63	144
562	2vM4Z	97	46	0	X	X	510	56	14	156	158
286	2M3Z	46	48	6	S	X	760	69	8	107	162
										Average =	138 ± 11
	-- depth group "3"										
522	3M4Z	52	20	2	X	X	310	42	10	76	106
510	3M4Z	45	30	2	X	X	220	44	10	73	112
525	3M4Z	52	30	3	X	X	280	47	12	81	113
515	3M4Z	61	32	4	X	X	350	45	12	98	125
523	3gM4Z	56	24	28	S	L	400	42	10	95	128
36	3M4Z	55	28	1	X	X	430	54	8	102	137
537	3gM4Z	35	32	7	S	X	400	60	16	80	150
										Average =	124 ± 13

TABLE 17. (Continued)

Plot No.	Mapping Unit	Average Age Actual	Depth Inches	Slope Percent	Aspect	Position	Elevation Feet	Average Total Precipitation Annual	Warm-Season	Average Height Actual	Site Index
Salkum -- depth group "2"											
215	3M3Z2	66	37	4	X	X	330	46	8	117	143
209	2M3Z2	62	48	2	X	X	435	48	8	121	153
210	2M3Z2	31	48	6	S	M	400	48	8	72	152
										Average =	149 ± 4
Clackamas -- depth group "1"											
44	1gM35Z2	86	60+	2	X	X	480	57	8	139	148
Camas -- depth group "2"											
261	2M5X	44	36	1	X	X	500	51	8	89	138
296	2M5Z	52	42	2	X	X	900	75	8	126	177
49	2M5Z	38	42	1	X	X	700	73	10	94	162
299	2M5XZ	40	36	5	S	X	1100	77	8	107	179
										Average =	164 ± 12
	-- depth group "3"										
48	3gM5Z	57	28	5	X	X	960	73	10	121	161
282	3M5XZ	31	24	1	X	X	710	71	8	78	165
290	3M5XZ	53	32	2	X	X	860	70	8	130	180
50	3M5Z	49	32	2	X	X	740	73	10	94	137
51	3gM5Z	62	28	3	X	X	780	76	12	114	144
31	3M5XZ	42	30	0	X	X	740	67	10	86	138
										Average =	154 ± 11

TABLE 17. (Continued)

Plot No.	Mapping Unit	Average Age Actual	Depth Inches	Slope Percent	Aspect	Position	Elevation Feet	Average Total Annual Precipitation	Warm-Season	Average Height Actual	Site Index
Chehalis -- depth group "1"											
211	1M5X	66	60	1	X	X	260	43	8	115	140
212	1M5X	33	60	1	X	X	260	43	8	72	144
10	1M5X	105	60+	0	X	X	125	37	8	170	167
13	1M5X	61	60+	0	X	X	125	37	8	129	165
										Average =	154 ± 9
Neŏberg -- depth group "1"											
11	1M57X	87	60	0	X	X	125	36	8	176	187
291	1M57X	46	60+	2	X	X	670	65	8	112	170
201	1M57X	52	60	1	X	X	260	40	8	117	164
										Average =	174 ± 7
571	1L6	60	60	40	S	L	60	48	12	109	140
Carlton											
76	2M42S	32	52	23	S	M	700	58	10	73	150
549	3M32S	42	30	0	X	X	500	60	16	82	132
Viola											
294	3M21B	37	60+	5	N	L	500	58	8	88	158

TABLE 18. Average site index of douglas fir on miscellaneous soils of different Series, mapping unit designations, and depth groups.

Series	Mapping unit symbol	Depth limits	Average site index and variation coefficient
Amity	1M23	60" or more	142 ± 9
Camas	2M5X, 2M5Z, 2M5XZ	36" to 60"	164 ± 12
Camas	3gM5Z, 3M5XZ, 3M5Z	20" to 36"	154 ± 11
Carlton	2M42S	36" to 60"	150*
Carlton	3M32S	20" to 36"	132*
Chehalis	1M5X	60" or more	154 ± 9
Clackamas	1gM35Z2	60" or more	148*
Hillsboro	1M5	60" or more	149 ± 4
Hillsboro	1M34	60" or more	173*
Newberg	1M57X	60" or more	174 ± 7
Salem	2M43Z, 2M4Z, 2vM4Z	36" to 60"	138 ± 11
Salem	3M4Z, 3gM4Z	20" to 36"	124 ± 13
Salkum	2M3Z2	36" to 60"	149 ± 4
Viola	3M21B	20" to 36"	158*
Willamette	1M34	60" or more	138 ± 4
Willamette	1M4, 1M54	60" or more	169 ± 5

* Not enough measurements to determine a reliable coefficient of variation.

TABLE 19. Average growth of douglas fir in the Willamette valley on medium-textured residual hill soils of north and level aspects.*

Average tree age - years		Average tree height - feet	
Actual	Reciprocal	Logarithm	Actual
30	.033,333	1.850,119	70.8
40	.025,000	1.961,607	91.5
50	.020,000	2.028,502	106.8
60	.016,667	2.073,095	118.3
70	.014,286	2.104,951	127.4
80	.012,500	2.128,846	134.5
90	.011,111	2.147,429	140.4
100	.010,000	2.162,293	145.3

* Calculated from equation #1. Total effective soil depth (X_2) held at the average or 50 inches. Calculations cover only the age range represented by the data except for the 100 year point.

TABLE 20. Average growth of douglas fir in the Willamette valley on medium-textured residual hill soils of south and level aspects.*

Average tree age - years		Average tree height - feet	
Actual	Reciprocal	Logarithm	Actual
28	.035,714	1.804,184	63.7
30	.033,333	1.837,236	68.8
40	.025,000	1.952,911	89.7
50	.020,000	2.022,319	105.3
60	.016,667	2.068,586	117.1
70	.014,286	2.101,638	126.4
80	.012,500	2.126,430	133.8
90	.011,111	2.145,712	139.9
100	.010,000	2.161,134	144.9
110	.009,091	2.173,753	149.2
120	.008,333	2.184,275	152.9
130	.007,692	2.193,173	156.0
140	.007,143	2.200,794	158.8
150	.006,667	2.207,402	161.2
160	.006,250	2.213,190	163.4

* Calculated from equation #2. Total effective soil depth (X_2) held at 48 inches, slope (X_3) held at 22 percent, elevation (X_4) held at 927 feet and average annual precipitation (X_5) held at 64 inches. Calculations cover only the age range represented by the data.

TABLE 21. Average growth of douglas fir in the Willamette valley on medium-textured soils of the Powell series. All aspects have been included.*

Average tree age - years		Average tree height - feet	
Actual	Reciprocal	Logarithm	Actual
28	.035,714	1.822,913	66.5
30	.033,333	1.852,059	71.1
40	.025,000	1.954,066	89.9
50	.020,000	2.015,272	103.6
58	.017,241	2.049,046	112.0
100	.010,000	2.137,684	137.3

* Calculated from equation #3. Total effective soil depth (X_2) held at the average or 41 inches. Calculations cover only the age range represented by the data except for the 100 year point.

TABLE 22. Solution of equation #2 for site index (age held at 100 years) with different numerical values of the variables. (Both the logarithm and site index in feet are shown.)

Slope %	Total effective soil depths -- inches								
	10	20	30	40	50	60	70	80	90
	Elevation 500 feet - Precipitation 45 inches								
20	2.077,638	2.099,528	2.121,118	2.143,308	2.165,198	2.187,088	2.208,978	2.230,868	2.252,758
	119.6	125.8	132.3	139.1	146.3	153.8	161.8	170.2	179.0
40	2.070,758	2.092,648	2.114,538	2.136,428	2.158,318	2.180,208	2.202,098	2.223,988	2.245,878
	117.7	123.8	130.2	136.9	144.0	151.5	159.3	166.9	176.1
80	2.056,998	2.078,888	2.100,778	2.122,668	2.144,558	2.166,448	2.188,338	2.210,228	2.232,118
	114.1	119.9	126.1	132.6	139.5	146.7	154.3	162.3	170.7
120	2.043,238	2.065,128	2.087,018	2.108,908	2.130,798	2.152,688	2.174,578	2.196,468	2.218,358
	110.5	116.2	122.2	128.5	135.2	142.1	149.5	157.2	165.3

TABLE 22. (Continued)

Slope %	Total effective soil depths -- inches 10	20	30	40	50	60	70	80	90
				Elevation 500 feet - Precipitation 65 inches					
20	2.089,718	2.111,608	2.133,498	2.155,388	2.177,278	2.199,168	2.221,058	2.242,948	2.264,838
	122.9	129.3	136.0	143.0	150.4	158.2	166.4	174.9	184.0
40	2.082,838	2.104,728	2.126,618	2.148,508	2.170,398	2.192,288	2.214,178	2.236,068	2.257,958
	121.0	127.3	133.8	140.8	148.0	155.7	163.7	172.2	181.1
80	2.069,078	2.090,968	2.112,858	2.134,748	2.156,638	2.178,528	2.200,418	2.222,308	2.244,198
	117.2	123.3	129.7	136.4	143.4	150.8	158.6	166.9	175.5
120	2.055,318	2.077,208	2.099,098	2.120,988	2.142,878	2.164,768	2.186,658	2.208,548	2.230,438
	113.6	119.5	125.6	132.1	138.9	146.1	153.7	161.6	170.0

TABLE 22. (Continued)

Slope %	Total effective soil depths -- inches								
	10	20	30	40	50	60	70	80	90
	Elevation 500 feet - Precipitation 85 inches								
20	2.101,798	2.123,688	2.145,578	2.167,468	2.189,358	2.211,248	2.233,138	2.255,028	2.276,918
	126.4	133.0	139.8	147.0	154.6	162.6	171.0	179.9	189.2
40	2.094,918	2.116,808	2.138,698	2.160,588	2.182,478	2.204,368	2.226,258	2.248,148	2.270,038
	124.4	130.9	137.6	144.7	152.2	160.1	168.4	177.1	186.3
80	2.081,158	2.103,048	2.124,938	2.146,828	2.168,718	2.190,608	2.212,498	2.234,388	2.256,278
	120.5	126.8	133.4	140.2	147.5	155.1	163.1	171.6	180.5
120	2.067,398	2.089,288	2.111,178	2.133,068	2.154,958	2.176,848	2.198,738	2.220,628	2.242,518
	116.8	122.8	129.2	135.8	142.9	150.3	158.0	166.2	174.8

TABLE 22. (Continued)

Slope %	Total effective soil depths — inches								
	10	20	30	40	50	60	70	80	90
	Elevation 500 feet - Precipitation 105 inches								
20	2.113,878	2.135,768	2.157,658	2.179,548	2.201,438	2.223,328	2.245,218	2.267,108	2.288,998
	130.0	136.7	143.8	151.2	159.0	167.3	175.9	185.0	194.5
40	2.106,998	2.128,888	2.150,778	2.172,668	2.194,558	2.216,448	2.238,338	2.260,228	2.282,118
	127.9	134.6	141.5	148.8	156.5	164.6	173.1	182.0	191.5
80	2.093,238	2.115,128	2.137,018	2.158,908	2.180,798	2.202,688	2.224,578	2.246,468	2.268,358
	123.9	130.3	137.1	144.2	151.6	159.5	167.7	176.4	185.5
120	2.079,478	2.101,368	2.123,258	2.145,148	2.167,038	2.188,928	2.210,818	2.232,708	2.254,598
	120.1	126.3	132.8	139.7	146.9	154.5	162.5	170.9	179.7

TABLE 22. (Continued)

Slope %	Total effective soil depths -- inches								
	10	20	30	40	50	60	70	80	90
	Elevation 1500 feet - Precipitation 45 inches								
20	2.054,638	2.076,528	2.098,418	2.120,308	2.142,198	2.164,088	2.185,978	2.207,868	2.229,758
	113.4	119.3	125.4	131.9	138.7	145.9	153.4	161.4	169.7
40	2.047,758	2.069,648	2.091,538	2.113,428	2.135,318	2.157,208	2.179,098	2.200,988	2.222,878
	111.6	117.4	123.4	129.8	136.6	143.6	150.0	158.8	167.1
80	2.033,998	2.055,888	2.077,778	2.099,668	2.121,558	2.143,448	2.165,338	2.187,228	2.209,118
	108.1	113.7	119.7	125.8	132.3	139.1	146.3	153.9	161.8
120	2.020,238	2.042,128	2.064,018	2.085,908	2.107,798	2.129,688	2.151,578	2.173,468	2.195,358
	104.8	110.2	115.9	121.9	128.2	134.8	141.8	149.1	156.8

TABLE 22. (Continued)

Slope %	Total effective soil depths -- inches								
	10	20	30	40	50	60	70	80	90
				Elevation 1500 feet - Precipitation 65 inches					
20	2.066,718	2.088,608	2.110,498	2.132,388	2.154,278	2.176,168	2.198,058	2.219,948	2.241,838
	116.6	122.6	129.0	135.6	142.7	150.0	157.8	165.9	174.5
40	2.059,838	2.081,728	2.103,618	2.125,508	2.147,398	2.169,288	2.191,178	2.213,068	2.234,958
	114.8	120.7	126.9	133.5	140.4	147.7	155.3	163.4	171.8
80	2.046,078	2.067,968	2.089,858	2.111,748	2.133,638	2.155,528	2.177,418	2.199,308	2.221,198
	111.2	117.0	123.0	129.3	136.0	143.1	150.5	158.2	166.4
120	2.032,318	2.054,208	2.076,098	2.097,988	2.119,878	2.141,768	2.163,658	2.185,548	2.207,438
	107.7	113.3	119.2	125.3	131.8	138.6	145.8	153.3	161.2

TABLE 22. (Continued)

Slope %	Total effective soil depths -- inches 10	20	30	40	50	60	70	80	90
				Elevation 1500 feet - Precipitation 85 inches					
20	2.078,798	2.100,688	2.122,578	2.144,468	2.166,358	2.188,248	2.210,138	2.232,028	2.253,918
	119.9	126.1	132.6	139.5	146.7	154.2	162.2	170.6	179.4
40	2.071,918	2.093,808	2.115,698	2.137,588	2.159,478	2.181,368	2.203,258	2.225,148	2.247,038
	118.0	124.1	130.8	137.3	144.4	151.8	159.7	167.9	176.6
80	2.058,158	2.080,048	2.101,938	2.123,828	2.145,718	2.167,608	2.189,498	2.211,388	2.233,278
	114.3	120.2	126.4	133.0	139.9	147.1	154.7	162.7	171.1
120	2.044,398	2.066,288	2.088,178	2.110,068	2.131,958	2.153,848	2.175,738	2.197,628	2.219,518
	110.8	116.5	122.5	128.8	135.5	142.5	149.9	157.6	165.8

TABLE 22. (Continued)

Slope %	Total effective soil depths -- inches								
	10	20	30	40	50	60	70	80	90
	Elevation 1500 feet - Precipitation 105 inches								
20	2.090,878	2.112,768	2.134,658	2.156,548	2.178,438	2.200,328	2.222,218	2.244,108	2.265,998
	123.3	129.7	136.4	143.4	150.8	158.6	166.8	175.4	184.5
40	2.083,998	2.105,888	2.127,778	2.149,668	2.171,558	2.193,448	2.215,338	2.237,228	2.259,118
	121.3	127.6	134.3	141.2	148.4	156.1	164.2	172.7	181.6
80	2.070,238	2.092,128	2.114,018	2.135,908	2.157,798	2.179,688	2.201,578	2.223,468	2.245,358
	117.6	123.6	130.0	136.8	143.8	151.2	159.1	167.3	175.9
120	2.056,478	2.078,368	2.100,258	2.122,148	2.144,038	2.165,928	2.187,818	2.209,708	2.231,598
	113.9	119.8	126.0	132.5	139.3	146.5	154.1	162.1	170.4

TABLE 23. Maximum, minimum and mean values of variables used in regression analyses showing tables from which the information is obtained and analysis numbers (see table 7) in which the data were used.

Item	Average Age, X_1			Total Soil Depth, X_2			Slope, X_3			Elevation, X_4		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean
Table #2	91	34	53	--	--	60.0	44	8	22.8	1700	275	769.6
Table #3	81	32	52	56	24	40.4	64	4	29.3	1760	250	702.4
Table #4	57	30	44	60+	22	48.3	10	0	3.6	1460	400	884.1
Table #5	207	28	50	--	--	60.0	55	6	24.3	2540	325	867.8
Table #6	160	30	58	56	18	37.9	136	7	33.6	2700	300	1002.5
Analysis #3	91	30	49	60+	22	49.8	64	0	17.4	1760	250	793.2
Analysis #6	207	28	52	60+	18	47.9	136	0	22.4	2700	325	926.7
Analysis #7	58	20	44	60+	20	40.7	45	2	20.6	900	240	553.3

TABLE 23. (Continued)

Item	Ave. Annual Precip., X_5			Ave. Warm-Season Precip., X_6			Ave. Tree Height, Y		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean
Table #2	81	40	55.7	10	6	8.0	161	83	112.7
Table #3	88	37	53.5	14	8	9.4	151	66	102.6
Table #4	88	41	65.9	19	6	13.5	122	60	95.9
Table #5	93	41	63.4	16	6	9.4	139	69	102.9
Table #6	106	39	62.2	16	8	11.0	155	71	105.4
Analysis #3	88	37	58.9	19	6	10.5	161	60	95.3
Analysis #6	106	39	63.6	19	6	11.1	155	60	102.0
Analysis #7	67	43	50.5	16	10	12.6	128	62	95.4

TABLE 24. Products of regression coefficients and different numerical values of each variable in equation #2.

Reciprocal of age X_1		Total soil depth - in. X_2		Percent slope X_3		Elevation - feet X_4		Average annual Precipitation - in. X_5	
Age	Value*	Depth	Value	Slope	Value	Elevation	Value	Precipitation	Value
	-		+		-		-		+
30	.462,714	10	.021,890	10	.003,440	300	.006,900	30	.018,120
40	.347,039	12	.026,286	15	.005,160	500	.011,500	35	.021,140
50	.277,631	18	.039,402	20	.006,880	800	.018,400	40	.024,160
60	.231,364	20	.043,780	25	.008,600	1000	.023,000	45	.027,180
70	.198,312	24	.052,536	30	.010,320	1200	.027,600	50	.030,200
80	.173,520	30	.065,670	35	.012,040	1500	.034,500	55	.033,220
90	.154,238	36	.078,804	40	.013,760	1800	.041,400	60	.036,240
100	.138,816	40	.087,560	45	.015,480	2000	.046,000	65	.039,260
110	.126,197	42	.091,938	50	.017,200	2200	.050,600	70	.042,280
120	.115,675	48	.105,072	55	.018,920	2500	.057,500	75	.045,300
130	.106,777	50	.109,150	60	.020,640	2800	.064,400	80	.048,320
140	.099,156	54	.118,206	65	.022,360	3000	.069,000	85	.051,340
150	.092,548	56	.122,584	70	.024,080	3200	.073,600	90	.054,360
		60	.131,340	75	.025,800	3500	.080,500	95	.057,380
				80	.027,520	3800	.087,400	100	.060,400
				85	.029,240			105	.063,420
				90	.030,960			110	.066,440
				95	.032,680			115	.069,460
				100	.034,400			120	.072,480
				105	.036,120			125	.075,500
				110	.037,840				
				115	.039,560				
				120	.041,280				

* These values are products of the regression coefficient and the reciprocal of age in each case.

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18. NOMOGRAPH FOR SOLVING EQUATION NO. 2. THIS MAY REPLACE FIGS. 10 THROUGH 17 IN THE KEY. ----------150

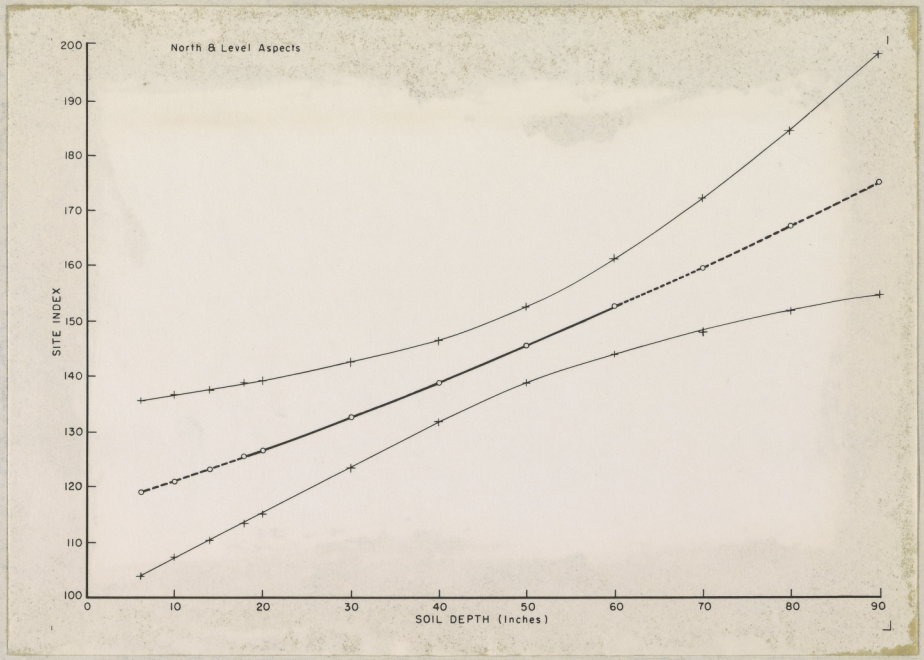


Fig. 1. Site index on north and level aspects as influenced by total effective depth of soil. Residual hill soils of medium surface-texture.

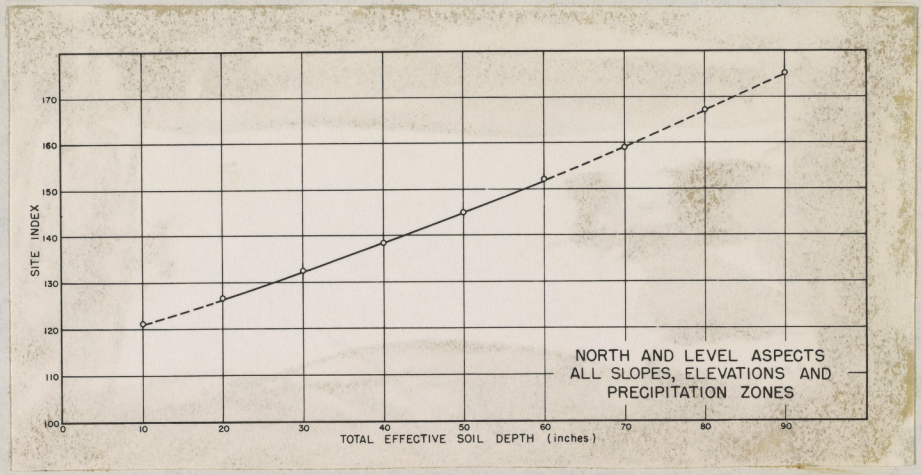


Fig. 1a. Same as fig. 1 but without fiducial bands and showing grid for easy interpolation. To be used with key.

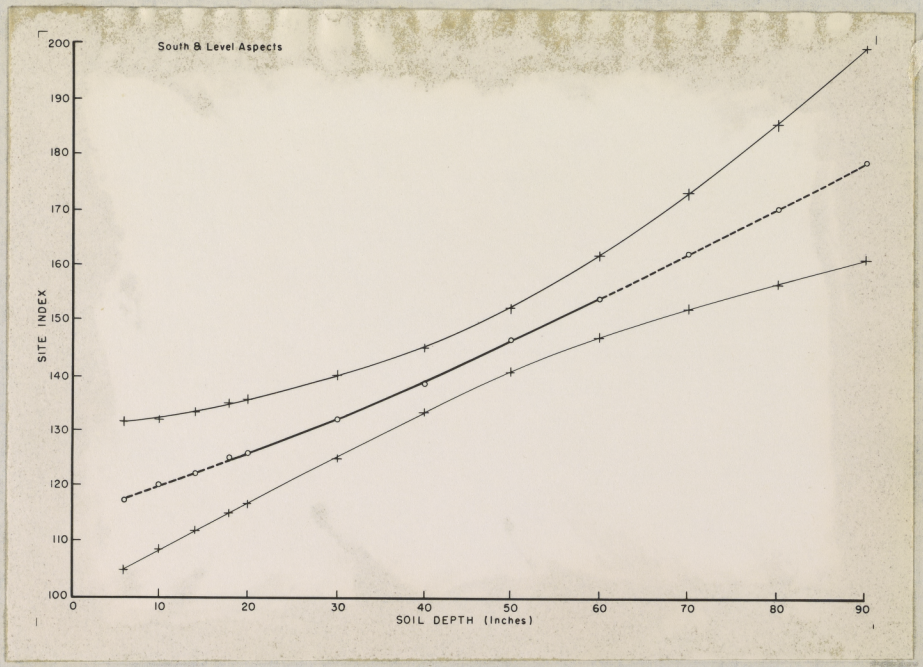
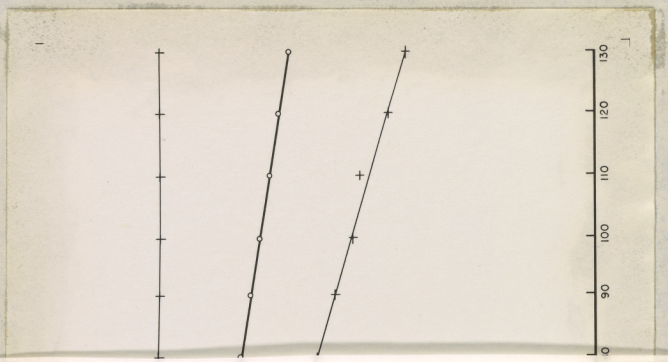


Fig. 2. Site index on south and level aspects as influenced by total effective depth of soil. Residual hill soils of medium surface-texture.



Errata - Fig. 3

Points on the regression and fiducial limit lines for 5 and 10 percent slopes are in error. The point on lower fiducial limit line for 110 percent slope is also in error. See table 10 for correct figures. When corrected the curve is a straight line. A corrected figure will be furnished to replace this one.

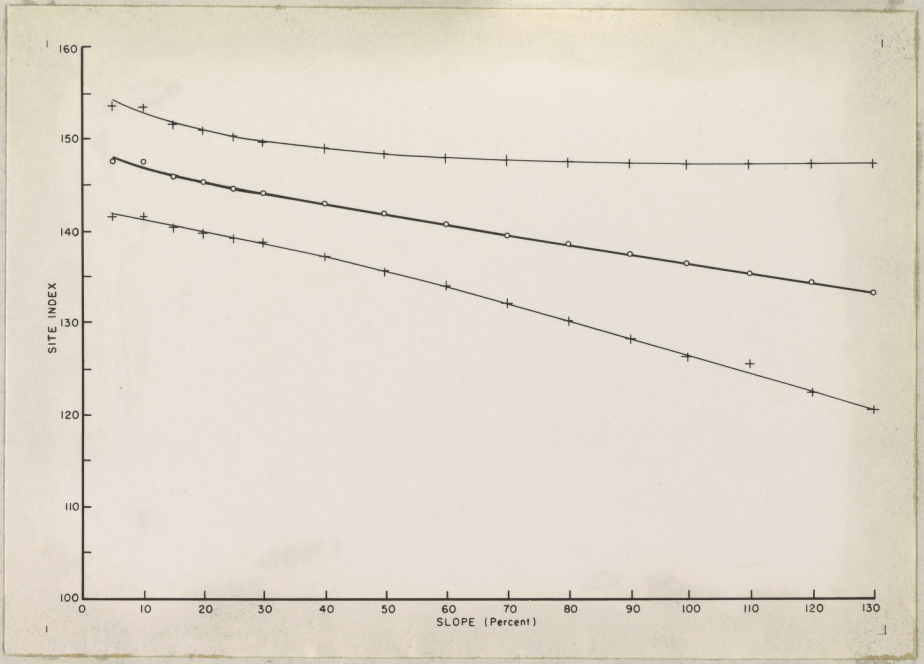


Fig. 3. Site index on south and level aspects as influenced by slope. Residual hill soils of medium surface-texture.

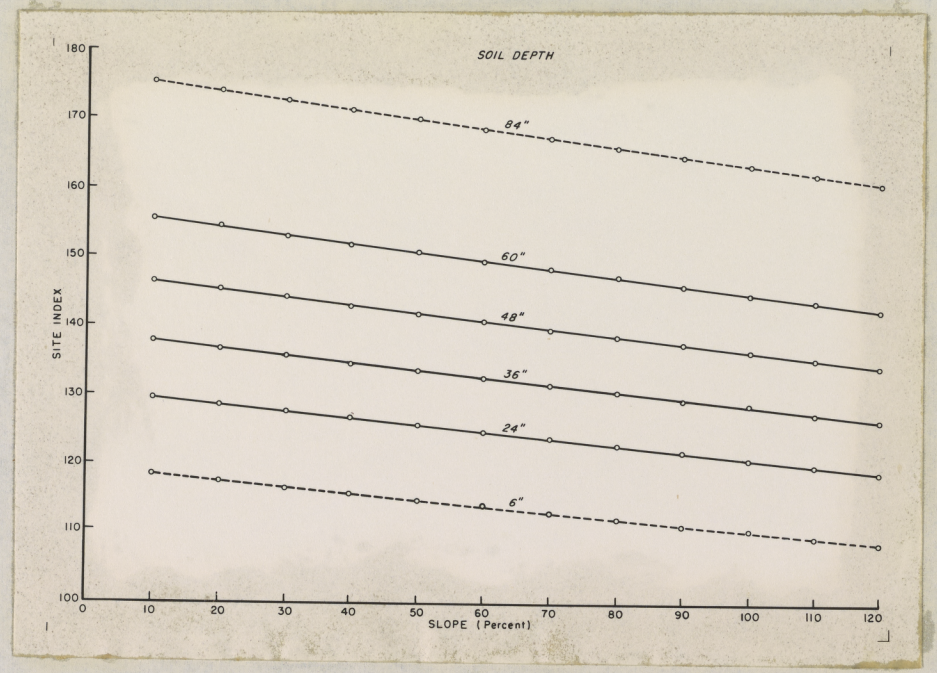
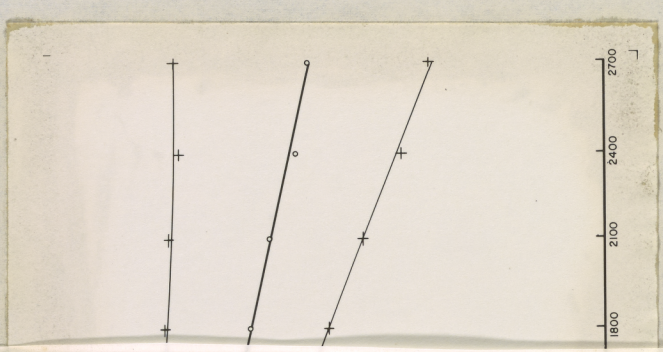


Fig. 4. Site index on south and level aspects as influenced by slope and different soil depths. Residual hill soils of medium surface-texture.



Errata - Fig. 5

Points on the regression and fiducial limit lines for 900 and 2400 feet elevations are in error. See table 12 for correct figures. When corrected, the curve is a straight line. A corrected figure will be furnished to replace this one.

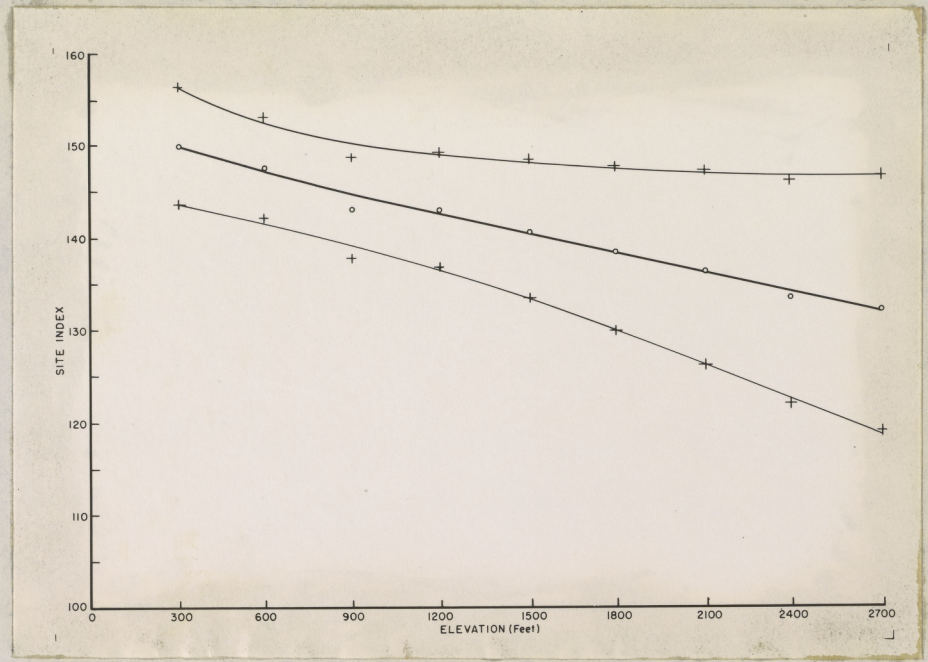


Fig. 5. Site index on south and level aspects as influenced by elevation. Residual hill soils of medium surface-texture.

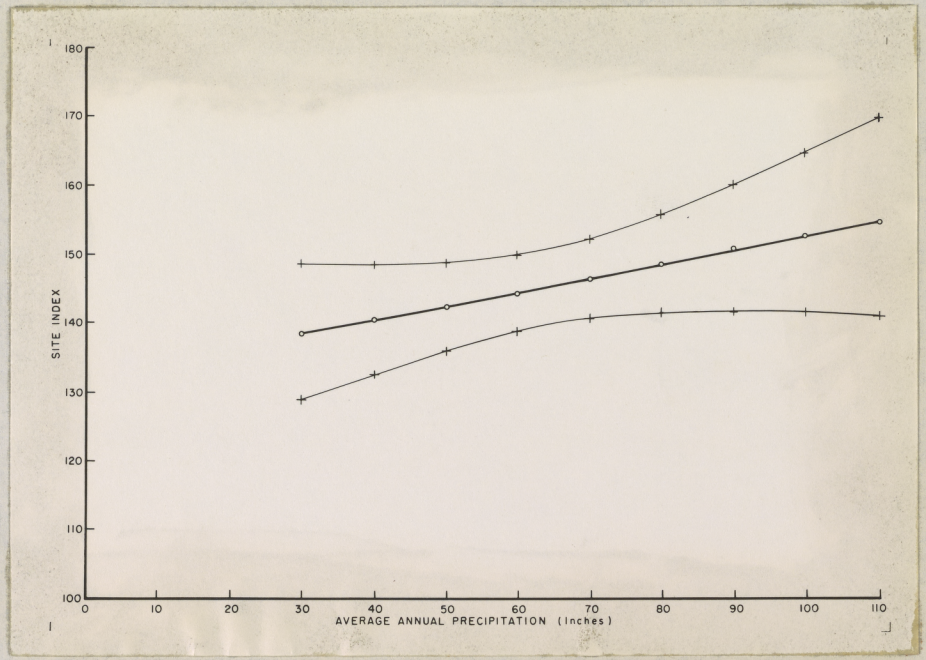


Fig. 6. Site index on south and level aspects as influenced by total annual precipitation. Residual hill soils of medium surface-texture.

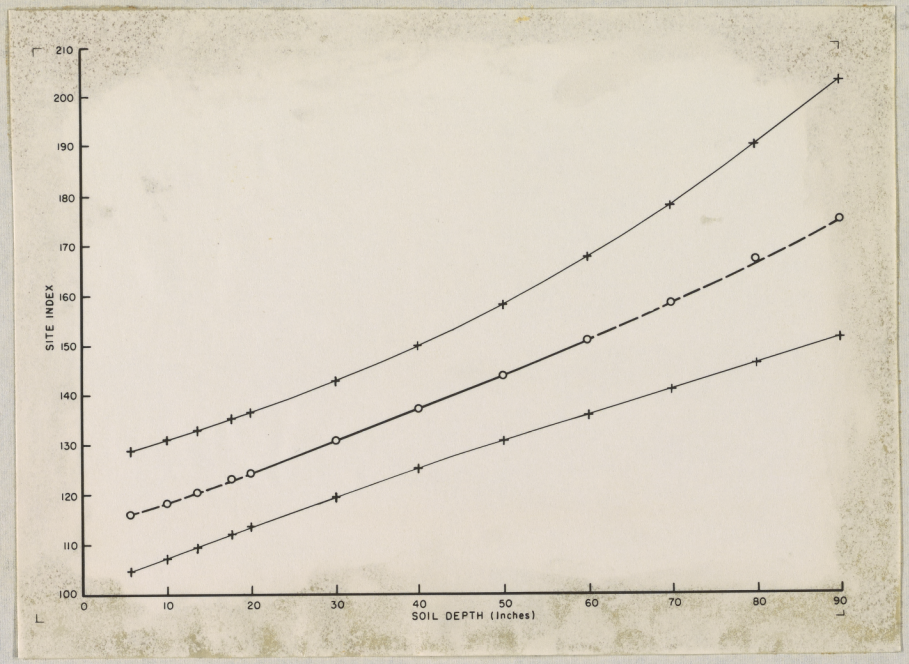


Fig. 7. Site index on all aspects and positions as influenced by total effective soil depth. Powell soil series of medium surface-texture.

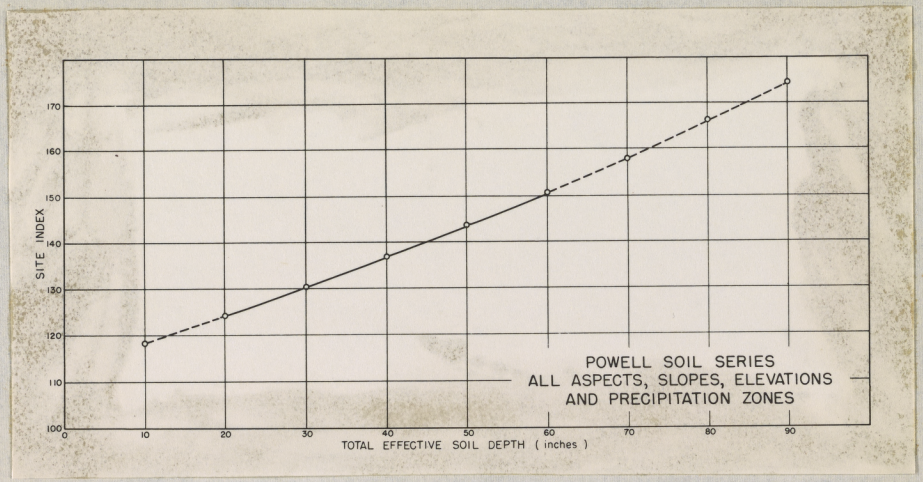


Fig. 7a. Same as fig. 7 but without fiducial bands and showing grid for easy interpolation. To be used with key.

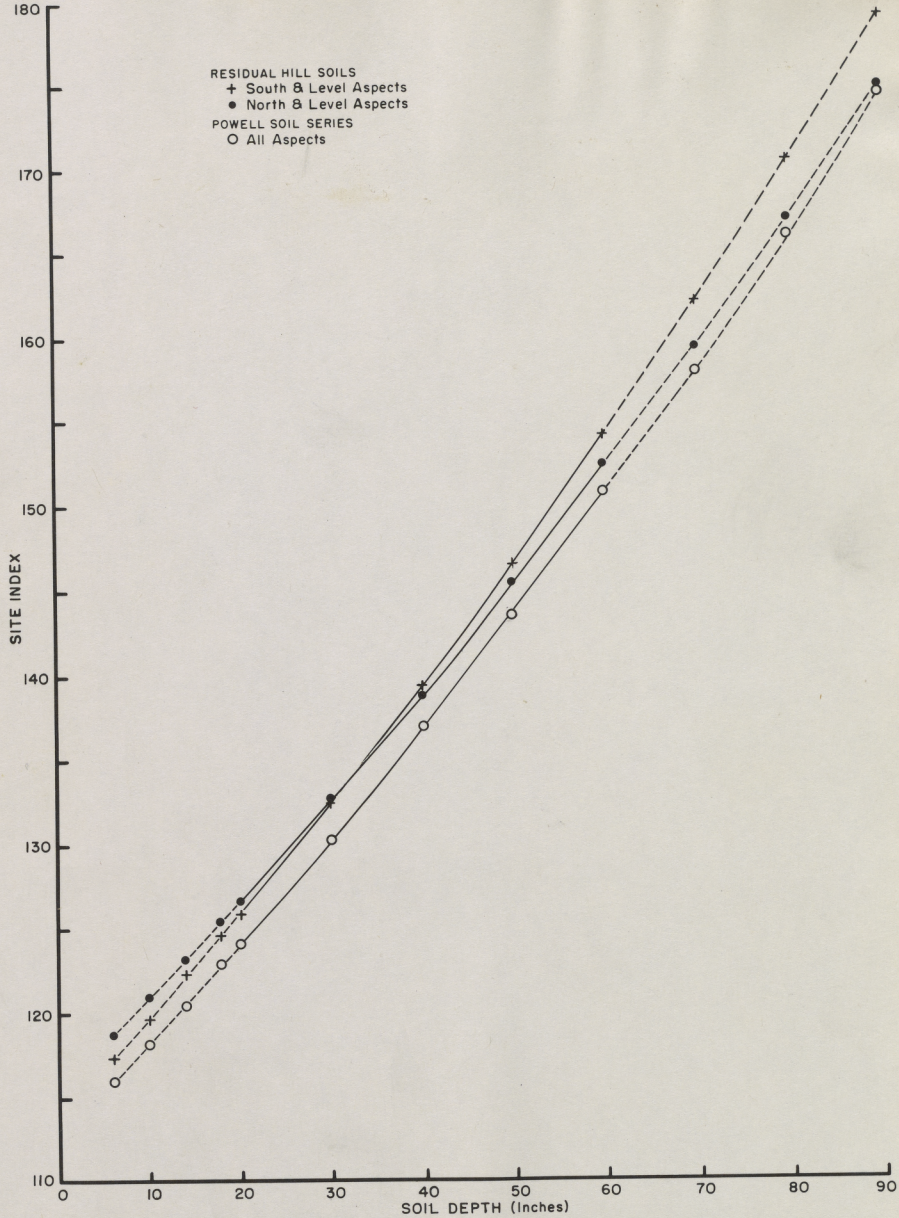


Fig. 8. Comparison of site index-soil depth relationships between residual hill soils of north and level aspects, south and level aspects and the Powell soil series of all aspects . (Information from figs. 1, 2, and 7).

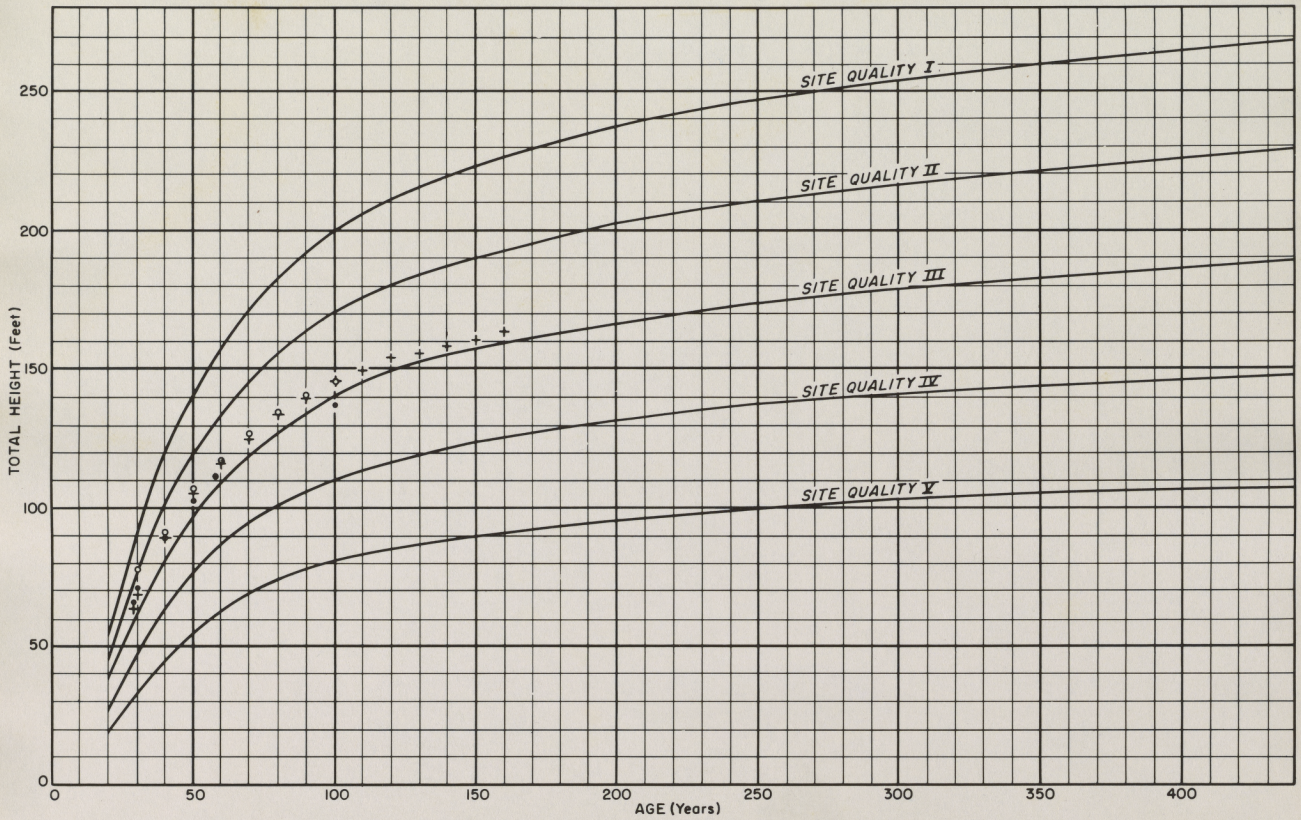


Fig. 9. Growth curves for douglas fir (after McArdle et al). Points representing average growth from these studies in the Willamette Valley have been superimposed for comparison.

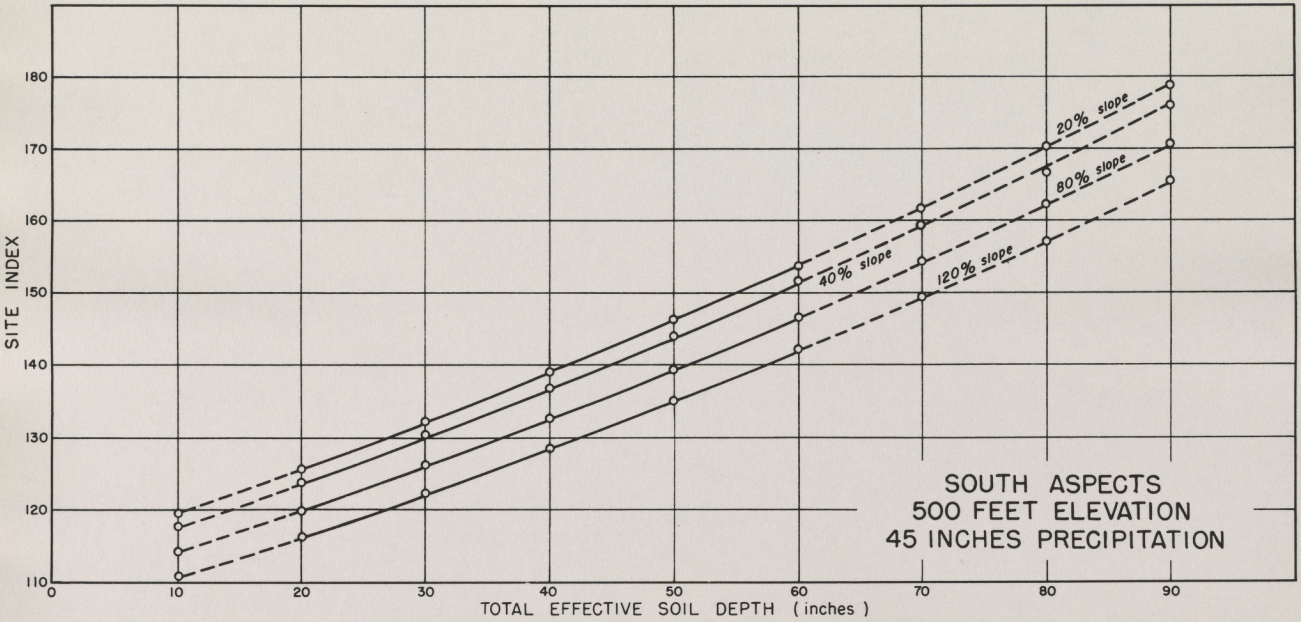


Fig. 10. Site index on south aspects at 500 feet elevation and 45 inches average annual precipitation as influenced by slope and total effective soil depth. Residual hill soils of medium surface-texture.

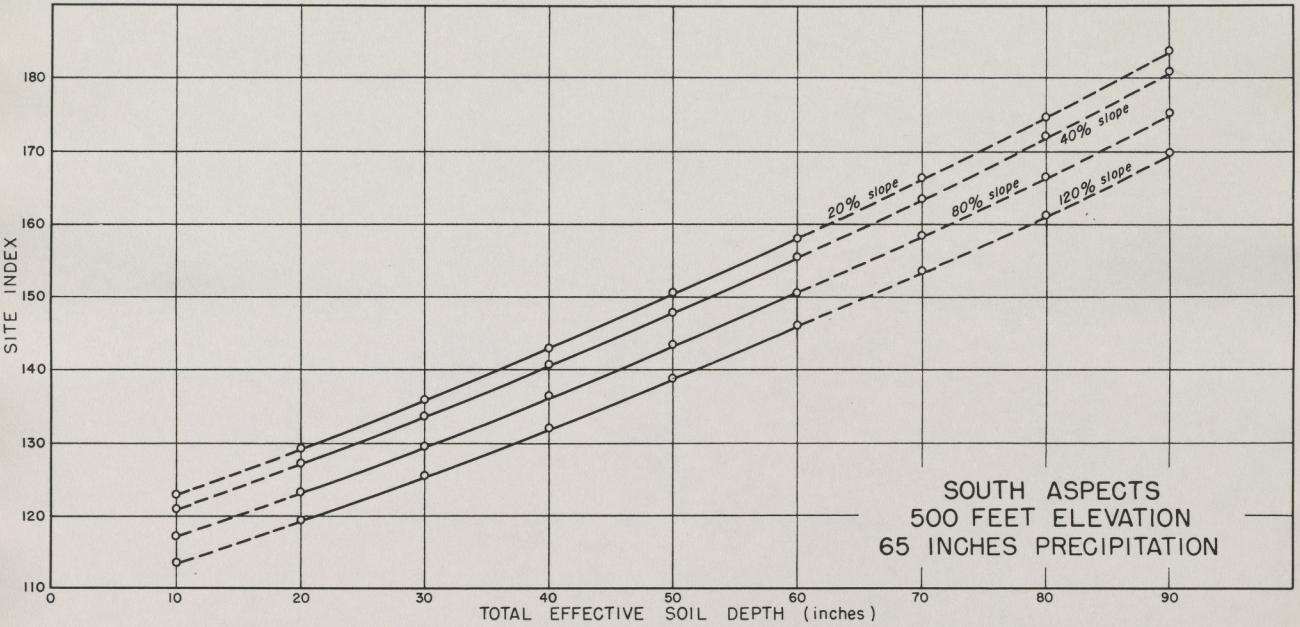


Fig. 11. Site index on south aspects at 500 feet elevation and 65 inches average annual precipitation as influenced by slope and total effective soil depth. Residual hill soils of medium surface-texture.

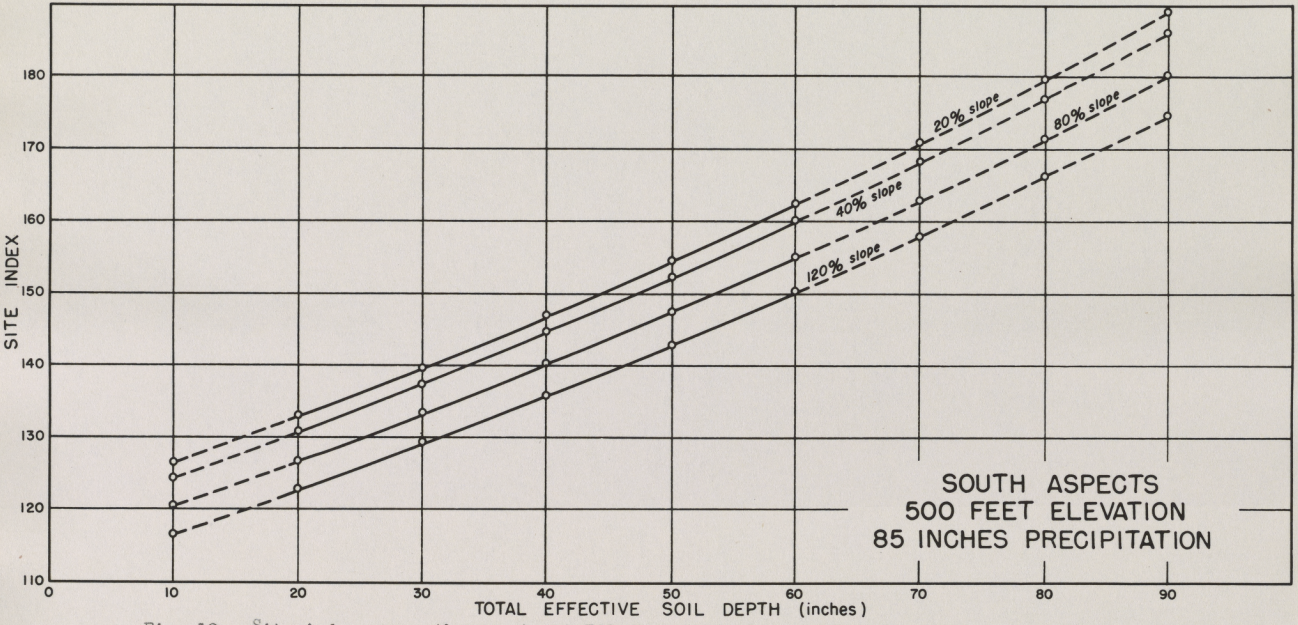


Fig. 12. Site index on south aspects at 500 feet elevation and 85 inches average annual precipitation as influenced by slope and total effective soil depth. Residual hill soils of medium surface-texture.

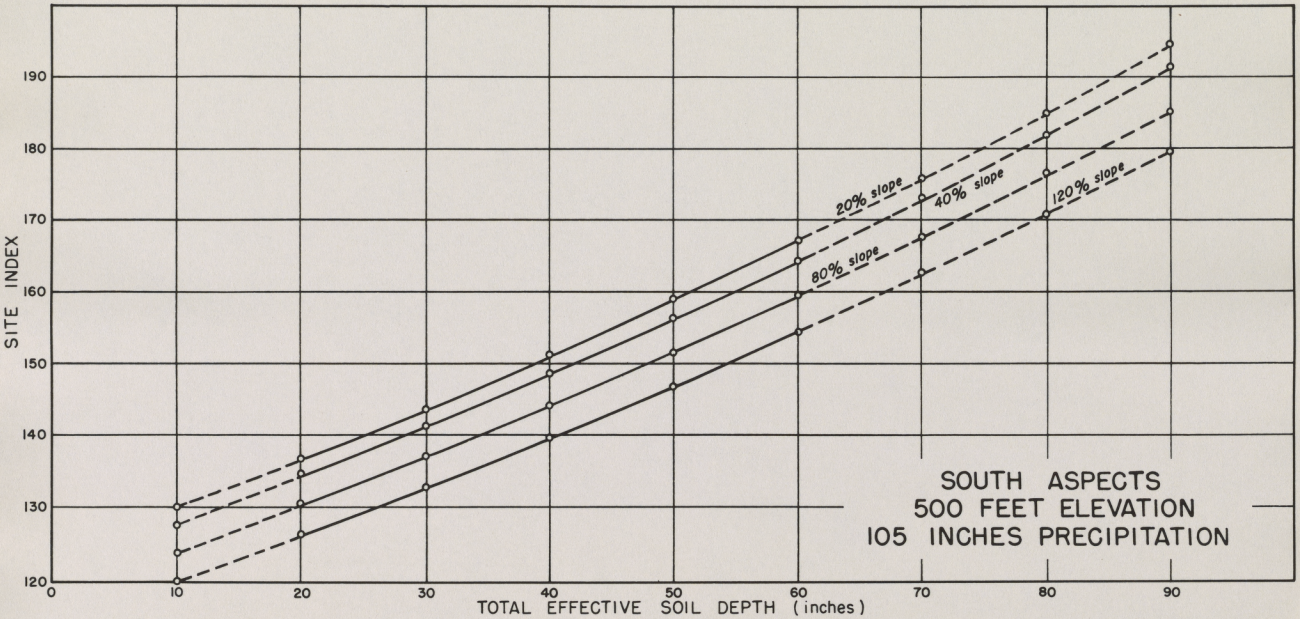


Fig. 13. Site index on south aspects at 500 feet elevation and 105 inches average annual precipitation as influenced by slope and total effective soil depth. Residual hill soils of medium surface-texture.

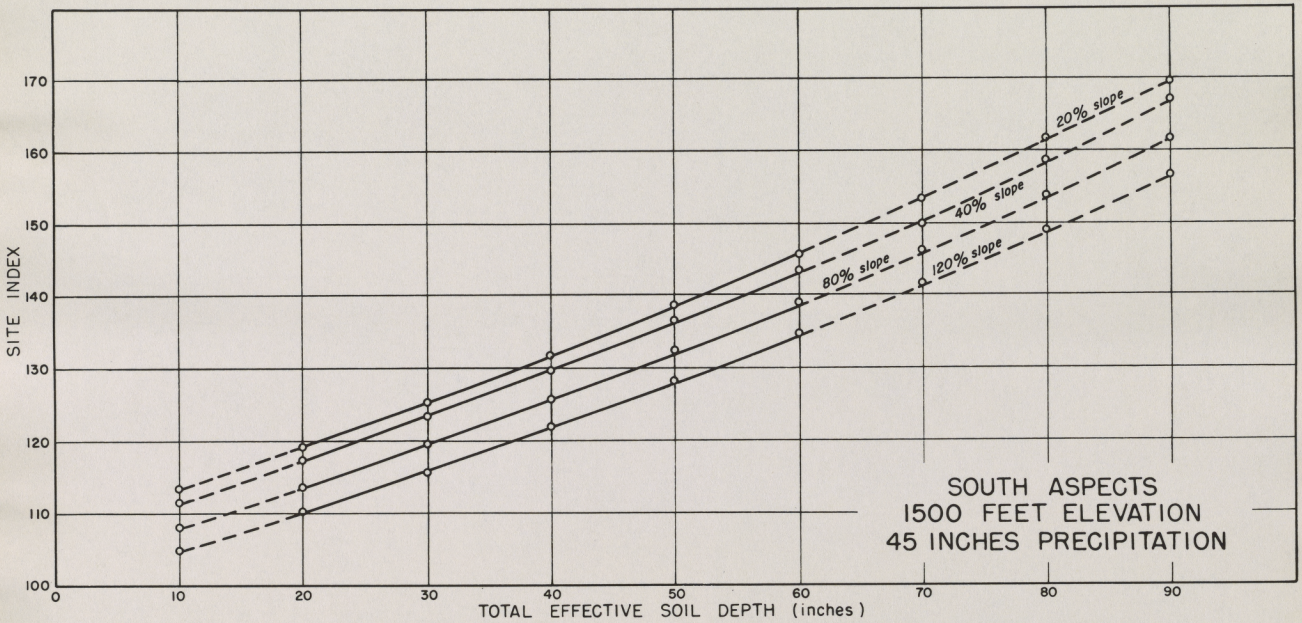


Fig. 14. Site index on south aspects at 1500 feet elevation and 45 inches average annual precipitation as influenced by slope and total effective soil depth. Residual hill soils of medium surface-texture.

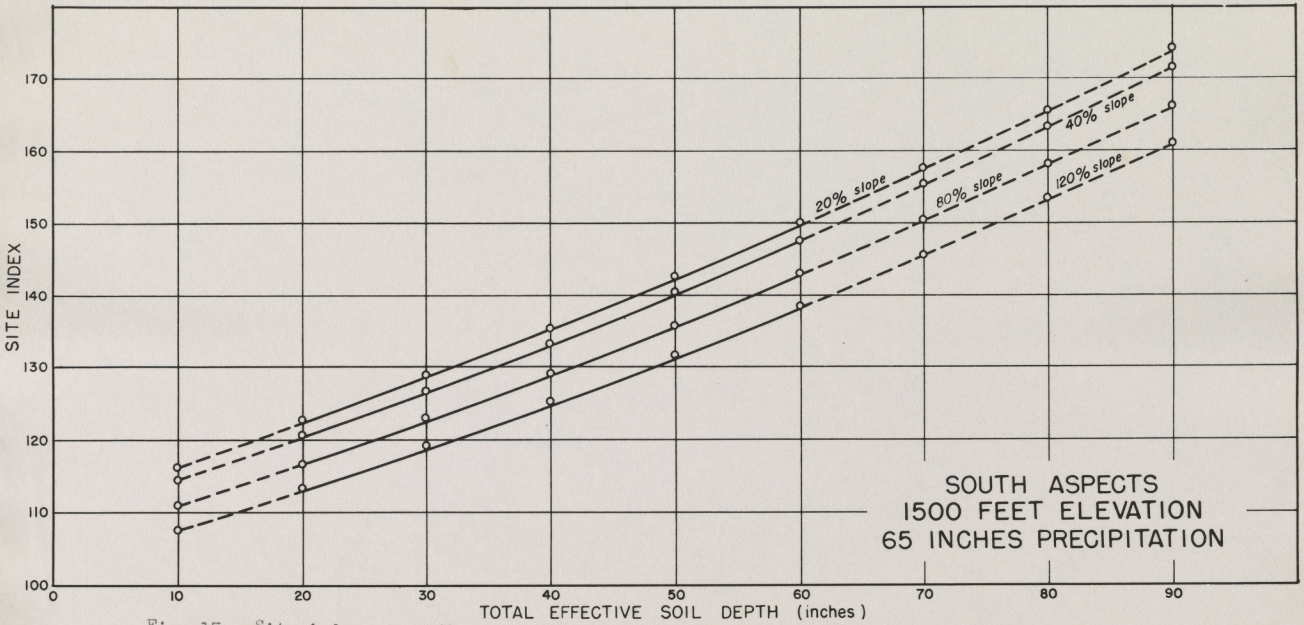


Fig. 15. Site index on south aspects at 1500 feet elevation and 65 inches average annual precipitation as influenced by slope and total effective soil depth. Residual hill soils of medium surface-texture.

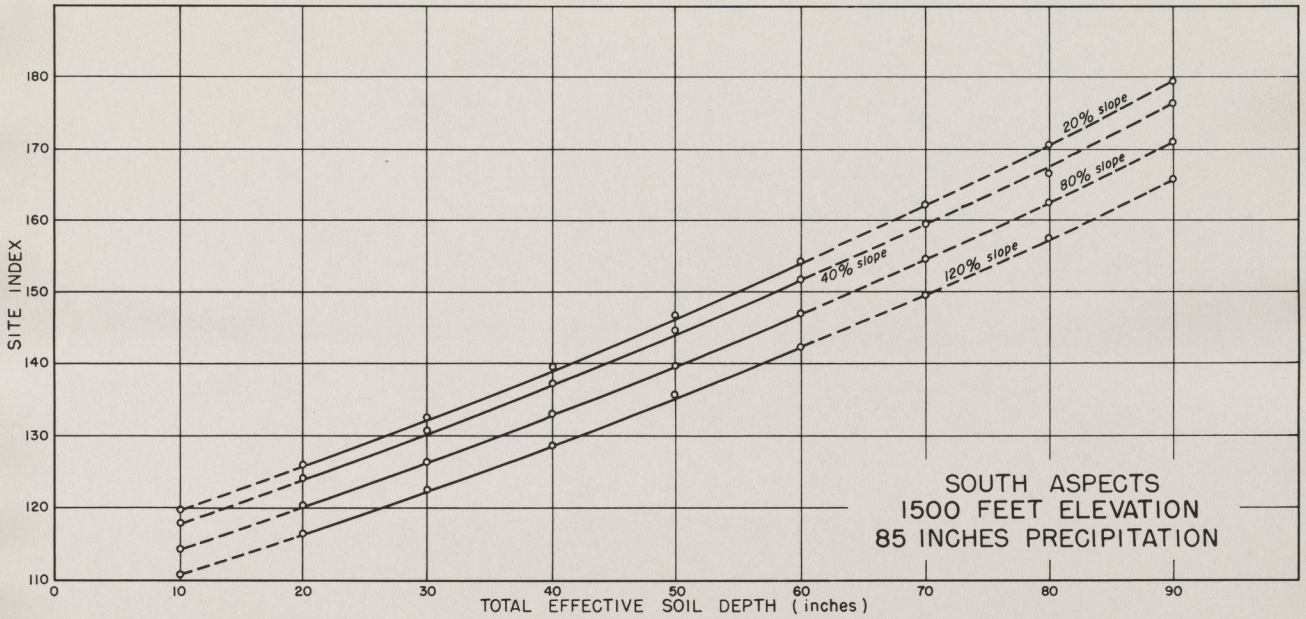


Fig. 16. Site index on south aspects at 1500 feet elevation and 85 inches average annual precipitation as influenced by slope and total effective soil depth. Residual hill soils of medium surface-texture.

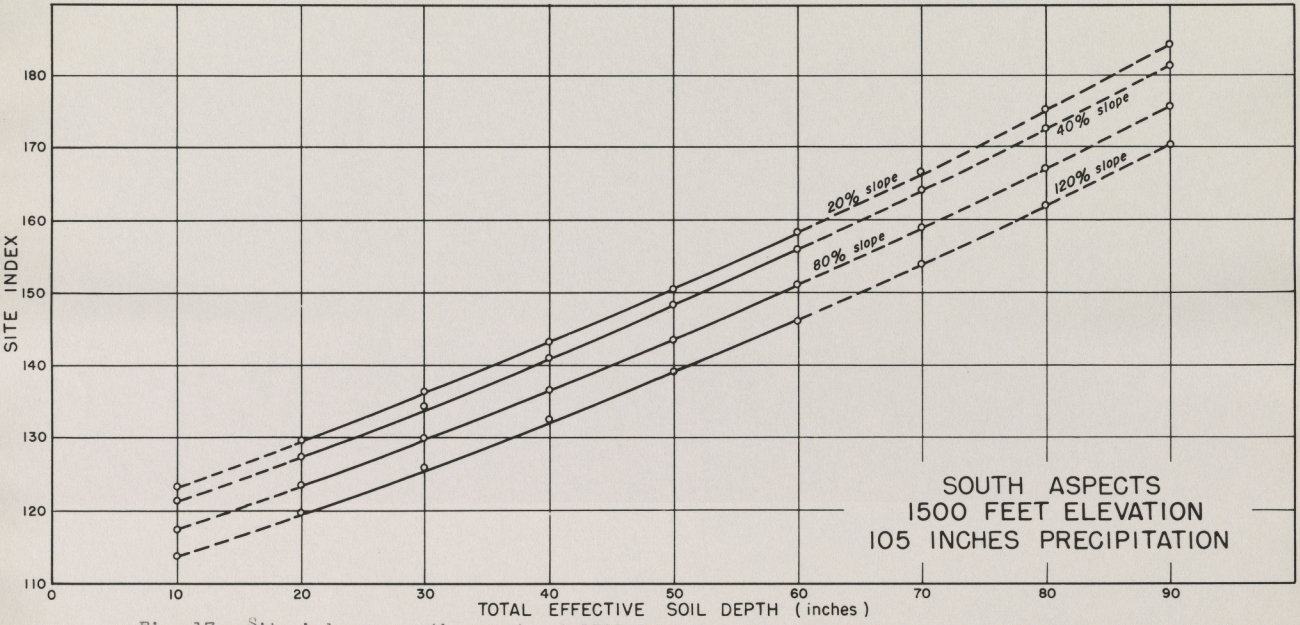
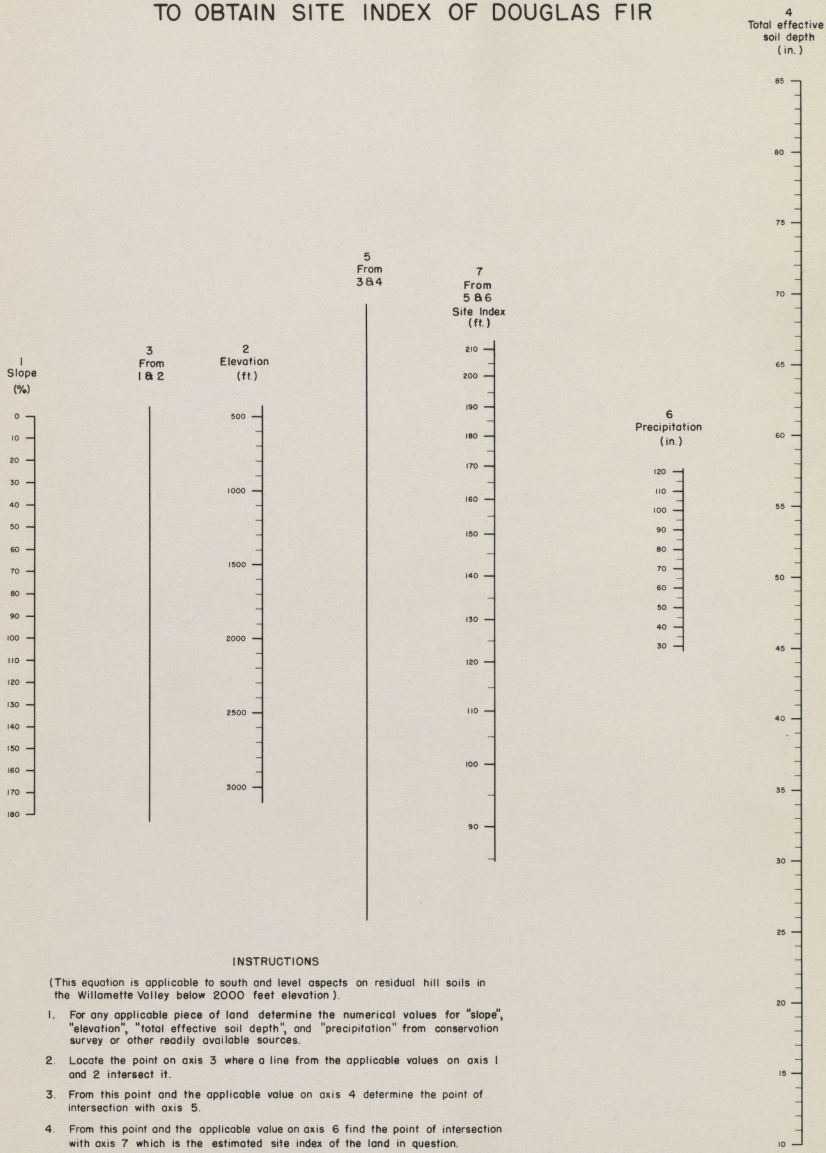


Fig. 17. Site index on south aspects at 1500 feet elevation and 105 inches average annual precipitation as influenced by slope and total effective soil depth. Residual hill soils of medium surface-texture.

NOMOGRAPH FOR SOLVING MULTIPLE REGRESSION EQUATION NO. 2 TO OBTAIN SITE INDEX OF DOUGLAS FIR



INSTRUCTIONS

(This equation is applicable to south and level aspects on residual hill soils in the Willamette Valley below 2000 feet elevation).

1. For any applicable piece of land determine the numerical values for "slope", "elevation", "total effective soil depth", and "precipitation" from conservation survey or other readily available sources.
2. Locate the point on axis 3 where a line from the applicable values on axis 1 and 2 intersect it.
3. From this point and the applicable value on axis 4 determine the point of intersection with axis 5.
4. From this point and the applicable value on axis 6 find the point of intersection with axis 7 which is the estimated site index of the land in question.

Fig. 18. Nomograph for solving equation No. 2. This may replace figs. 10 through 17 in the key.